PATENT ABSTRACTS OF JAPAN

(11)Publication number : 10-269538
(43)Date of publication of application : 09.10.1998

(51)Int.CI. G11B 5/49
G11B 21/21

(21)Application number : 09-142717
(22)Date of filing : 30.05.1997

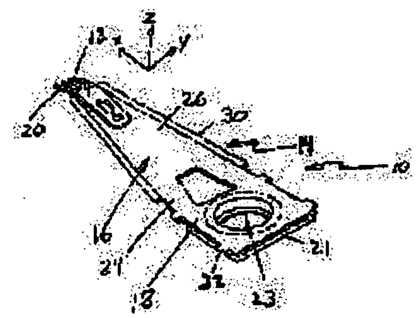
(71)Applicant : HUTCHINSON TECHNOL INC
(72)Inventor : GIRARD MARK T

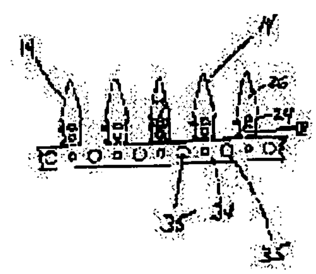
(30)Priority

Priority number	Priority date	Priority country
96 655849	31.05.1996	US
96 656639	31.05.1996	US
96 657778	31.05.1996	US

(54) THERMAL ADJUSTMENT SYSTEM FOR MAGNETIC HEAD SUSPENSION DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To adjust load, a still attitude roll and a radial geometric shape of a suspension device.
SOLUTION: This device is provided with a clamp, a load engagement member, an actuator, a laser and a control system. The mounting range of the suspension device 14 houses and holds releasably the clamp, and a load beam 16 engages and supports the load beam engagement member on an adjusting position for the clamp, and the load beam member drives and positions the actuator, and IR beam from the laser is turned to the spring range 24 of the suspension device 14 by an optical fiber, and the control system is provided with a pre-adjustment input terminal, a memory and a controller. The adjustment data showing a load beam adjusting position are stored in the memory, and the controller is connected to the pre-adjustment input terminal, the actuator, the laser and the memory, and the controller accesses the memory as a measurement value deciding an adjusting position, and operates the actuator to position the load beam 16 on the adjusting position after the load beam 16 is stress released.





LEGAL STATUS
[Date of request for examination] 18.05.2004
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]

CLAIMS

[Claim(s)]
[Claim 1] It is made the head suspension system regulating system for adjusting one or two or more parameters of the suspension system of the type which has the load beam equipped with the spring range, the installation range of the base side edge section, and the head hold range of the distance side edge section. The load beam engagement member for engaging with a load beam and supporting the load beam concerned to the adjustment position to the installation range, The actuator for driving and positioning the load beam engagement member concerned, The heat source for [of a load beam] applying heat to the spring range at least, The memory for memorizing the parameter adjustment data which express with a suspension system the suspension system parameter adjustment position it made [adjustment position] to be equipped with desired postadjustment parameter value after stress release of the load beam is carried out, The head suspension system regulating system which comes to have the controller which connects with the above-mentioned actuator, a heat source, and memory, operates an actuator as an operation of parameter adjustment data, and operates a heat source in order to adjust one or two or more parameters of a suspension system to desired parameter value.
[Claim 2] The head suspension system regulating system according to claim 1 carry out operating an actuator as parameter adjustment data and an operation of the measured pre adjustment parameter value in order come to have a pre adjustment input terminal for receiving the information as which the above-mentioned system expresses one or two or more pre adjustment parameter value by which the suspension system was measured further , and the above-mentioned controller connects also with the pre adjustment input terminal concerned and to adjust one or two or more parameters of a suspension system to desired parameter value as the description .
[Claim 3] It comes to have a postadjustment input terminal for receiving the postadjustment measurement data with which the above-mentioned system expresses one or two or more postadjustment parameter value by which the suspension system was measured further. The head suspension system regulating system according to claim 1 or 2 characterized by the above-mentioned controller making the newest thing the parameter adjustment data memorized by memory as an operation of the difference between one or two or more postadjustment parameter value which were measured, and desired parameter value.
[Claim 4] A head suspension system regulating system given in any 1 term of claims 1-3 to which parameter value to which one or plurality was adjusted is characterized by coming to have one or the plurality of a suspension system gram load, a quiescence posture, and the profile-geometry.
[Claim 5] It is made the approach for adjusting one or two or more parameters of the suspension system of the type which has the load beam equipped with the spring range, the installation range of the base side edge section, and the head hold range of the distance side edge section. After stress release of the load beam is carried out, the parameter adjustment data which express with a suspension system the adjustment position it made [adjustment position] to be equipped with desired postadjustment parameter value are memorized, After stress release of the load beam is carried out, a load beam is positioned to the adjustment position which parameter adjustment data are accessed [adjustment position] and makes it a suspension system equipped with desired postadjustment parameter value, How to consist of a thing of a load beam for which heat is applied to the spring range at least, in order to carry out stress release of the load beam while the load beam is positioned by the adjustment position.
[Claim 6] Memorizing parameter adjustment data It comes to have memorizing the parameter adjustment data which express one or two or more parameter value with a suspension system as an operation of the load beam adjustment position it made [adjustment position] to be equipped with desired postadjustment parameter value after stress release of the load beam is carried out. and after stress release of the load beam is carried out, accessing parameter adjustment data as an operation of one measured or two or more pre adjustment parameter value The approach according to claim 5 characterized by coming to have positioning a load beam to the adjustment position which parameter adjustment data are accessed [adjustment position] and makes it a suspension system equipped with desired postadjustment parameter

value.
[Claim 7] Furthermore, the approach according to claim 5 or 6 characterized by making parameter adjustment data into the newest thing as a function of one measured or two or more postadjustment parameter value.
[Claim 8] An approach given in any 1 term of claims 5-7 for adjusting one or the plurality of a suspension system gram load, a quiescence posture, and the profile-geometry.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is a machine for adjusting the property of the suspension system (suspension) used for a magnetic-disk drive head gimbal assembly with rigidity. Especially this invention is a machine for adjusting the gram load (loading) of the suspension system sounded with a roll, or a head gin PAL assembly, an outline configuration, and a static (quiescence) posture.
[0002]
[Description of the Prior Art] The head gin PAL assembly (HGAs) known also as a head suspension system assembly (HSAs) is usually used for the magnetic-disk drive with rigidity, in order to support the magnetic head which approaches the desk front face to rotate extremely. Such a gin PAL assembly 10 is shown in drawing 1 . Like illustration, the gin PAL assembly 10 has the pneumatic-bearing head slider assembly 12 attached in the suspension system 14. It has the load beam 16, and this load beam 16 has the attachment field (installation range) 18 in that end face, and a suspension system 14 has a gin PAL or a flection 20 at that end. It is ************** so that the attachment field 18 may be attached at the actuator or positioning arm which supports the gin PAL assembly 10 above a rotation desk at the time of ** included in a desk drive (not shown). In order to prepare the device for carrying out attachment immobilization of the gin PAL assembly in the increase of rigidity and the positioning arm of an attachment field, as for the substrate 21 which has the attachment boss 23, being welded to the attachment field 18 is typical. The load beam 16 has the long and slender spring field (spring range) 24 which is often a triangle-like member generally and adjoined the attachment field 18, and the hard field (rigid range) 26 which has extended from the spring field. The spring field 24 of the gestalt of operation shown in drawing 1 has the feed hole which forms a spring field in the two legs. With the gestalt of this operation, a flection 20 is manufactured as a separate member and welded to the end of the hard field 26. As for the pneumatic-bearing head slider assembly 12, it is typical to have the magnetic head (for it not to be visible to drawing 1), and to be combined with a flection 20 by adhesives.
[0003] The long and slender carrier strip which has the load beam blank of two or more **** shaping in even prolonged from there is chemically etched from the sheet metal of stainless steel or other spring materials during manufacture of a suspension system 14. The carrier strip which has the flection blank of **** shaping in even is etched by the same method from the sheet metal of stainless steel. the z-axis from under the continuing fabrication operation, the side rail 30, the lead-wire capture 32, a load point impression (it is not visible), or the almost flat field of the load beam 16 -- meeting -- the upper part -- or other structures (namely, the thing known as a z height direction -- setting) prolonged below are fabricated by the mechanical bending process on a load beam. the structure on the flection blank which needs deformation of z height (for example, a load point -- not shown) is fabricated by the same method. A flection 20 is welded to the end of the load beam 16 after shaping. A substrate 21 is also welded to the attachment field 18 of the load beam 16 following a fabrication operation.
[0004] It illustrates, and the suspension system 14 mentioned above is known as a three-piece design in that it has the load beam 16, a flection 20, and a substrate 21, and the all are fabricated, before being manufactured separately and welded together. By other suspension system designs known as a gimbal suspension system (not shown) unified [which were unified and was two-piece-designed], a flection is etched at the end of the field where a load beam is hard. The part of the unified gimbal which is prolonged in the z height direction from the field where a load beam is flat is fabricated with other structures on a load beam during shaping. As for a substrate, it is typical to be welded to these load beams, unified gimbal etching, and the attachment field after a fabrication operation.
[0005] As shown in drawing 2 , these etching, shaping, and the product of welding operation are the carrier strips 34 to which the almost even suspension system 14 has extended from the carrier strip 34 (that is, the attachment field 18, the

spring field 24, and the field 26 where a load beam is hard are on the same flat surface mostly, and is in the same z height). or [that the spring field 24 of each load beam 16 bends a spring field plastically during the continuing fabrication operation] -- or whether it winds around the surroundings of the mandril which curved so that it might be made to deform, or it bends by other approaches carry out, and it is made. As shown in drawing 3 and 4, this volume actuation gives the configuration which curved to the spring field 24, and when a suspension system 14 is in that non-loaded condition, i.e., free condition, a flection 20 shifts in the z height direction from the attachment field 18. The facility for performing these volume actuation and an approach are mostly learned for the U.S. Pat. No. 5,471,734 number by the U.S. Pat. No. 4,603,567 number by Smith etc., a hatch way, etc., and are indicated there.

[0006] As mentioned above, the suspension system 14 supports the slider assembly 12 above the magnetic disk. By the reaction over the pneumatic pressure of the front face of the rotating desk, the force on hydrodynamics is generated, therefore a slider assembly is lifted from a desk front face, and the slider assembly 12 "flies" the upper part. As for the head gin PAL assembly 10, the spring field 24 where the suspension system 14 is attached in the desk drive by loaded condition, therefore the suspension system was bent pushes aside the head slider assembly 12 toward a magnetic disk so that it may raise on this hydrodynamics and may react in the force. The height to which the slider assembly 12 flies the upper part of a desk side is known as "premature start height." The force which a suspension system 14 exerts on the slider assembly 12 is known as a "gram load." High desk drive actuation of the engine performance needs to follow with closely fixed height and a closely fixed posture for the magnetic-disk side which the pneumatic-bearing head slider assembly 12 rotates. In order to satisfy this criticality-demand, the gram load of a suspension system 14 must be adjusted to the design-specification range (beyond the gram load of nominal rating of a request and the gram load of the design specification of the range of the following upper parts and a lower part were defined, respectively) carried out comparatively just.

[0007] The technique for adjusting the gram load of the suspension system 14 of Ushiro who rolled the suspension system 14 is mostly known from the U.S. Pat. No. 5,297,413 number by the U.S. Pat. No. 4,603,567 number by Smith etc., Sean, etc., and is indicated. If it says simply, such one approach is learned as "heat (thermal) adjustment" or an "optical adjustment" technique. The property of common knowledge of a stainless steel member like a load beam can be decreased by exposing the force done in response to bending those members to heat energy (stress relaxation). The functional relationship between the decrement of the force in which a member is done, and the amount of heat can be determined experientially. The optical preparation uses this relation determined experientially so that it may become a "lower part gram", namely, so that the gram load of the load beam intentionally manufactured so that it might have an early larger gram load than a desired gram load range may be lowered (for example, volume actuation of the class mentioned above).

[0008] The facility for performing the optical preparation has a clamp for binding the attachment field 18 of a suspension system 14 tight to the fixed base or datum level, and a load cell for measuring the gram load of a suspension system. The actuator by which computer control is carried out moves a load cell so that it may engage with a flection 20, and it raises a flection to z height or a bias location about the datum level which is in agreement with the specific fly height for a suspension system (that is, a gram load is measured in fly height). In case a flection 20 is raised, the measured gram load actually goes up quickly toward this value at that time. If the measured gram load reaches the design specification of the upper part range, a computer will act, namely, a high intensity infrared lamp will be turned ON, and heat will be applied to the load beam 16. Since the applied heat decreases the actual gram load of a suspension system 14, the measured gram load reaches a peak quickly. If heat is applied continuously, the measured gram load will decrease with time amount. The measured gram load decreases, a predetermined set point and when it becomes a load between the gram load of nominal rating or a request, and a lower part range design specification typically, a computer is stopped, namely, a lamp is turned off. Once a lamp is turned off, in case the heat of a suspension system 14 disappears, the minimum value will be reached by reduction of the gram load measured becoming slow quickly (against gram load often lower than a lower part range design specification). However, the measured gram load increases and it is stable with a load value that it is design-specification within the limits at the balance or the last which approached the nominal design specification ideally [it is perfect, and is desirable and] as a load beam continues cooling. Moreover, like an optical adjustment fault, the last gram load continues and is measured. This measured value is used by computer, in order to update continuously the model (for example, set point) with which the applied heating value (for example, ON time amount of a lamp) and functional-related [between gram load reduction] were memorized in order to optimize the precision of the result obtained like the gram adjustment fault.

[0009] The mechanical bending process by which computer control was carried out is used also in order to adjust the gram load on the load beam 16. The mechanical approach of bending uses the relation as which the load beam 16 was determined experientially between change to which the amount bent mechanically and the gram load related. In order to

describe this relation correctly for the range of the gram load adjustment typically performed by this technique, the easy linearity return line was found out. This technique is actually carried out by computer connected with the bending device and load cell of a stepper motor drive. The relation between change of a gram load and the number of motor steps (namely, the amount or range where required bending was related) is memorized by the computer. After this gram load at that time of a suspension system is measured by the load cell, a computer calculates required load amendment (namely, difference between measuring load and a desired load). And a model is accessed according to amendment required in order to determine the number of motor steps required to attain the load amendment which needs a computer, therefore a stepper motor is made to act. Once a load beam is bent, it will be used, in order that this gram load at that time may be measured again and may update a model. In advance of implementation of the following mechanical bending, return line data are re-calculated using the data measured from the number with which mechanical bending carried out most recently was given.

[0010] After being set up using an approach which the gram load of a suspension system mentioned above first, the pneumatic-bearing head slider assembly 12 is attached in a flection 20, and lead wire is clamped with the load beam 16. Unluckily, the mechanical handling and mechanical assembly process which are included in this manufacture actuation will carry out the gram load of the sometimes assembled head suspension system assembly 10 more than the design-specification range. Since it is very criticality-like [a gram load design specification] for proper desk drive actuation, the head suspension system assembly besides these design specifications cannot be used if a gram load is not readjusted to the design-specification range. The machine which uses for a "rig ram" suspension system both the optical adjustment mentioned above and a mechanical bending process is shown in the U.S. Pat. No. 5,297,413 number by Shane etc.

[0011] The criticality-criteria relevant to other engine performance of a suspension system are mentioned about the resonance characteristic. or [, as for a suspension system 14, moving actuation of a positioning arm to a slider assembly correctly, since the head slider assembly 12 is correctly positioned about the truck of the request on a magnetic disk] -- or it must be able to carry. However, the property of the proper of the mechanical system which moves is that there is an inclination at which a mechanical system can turn in the mode in which a large number differ or which can be twisted, when driving forward and backward at a certain rate known as resonance frequency. or [namely, / that a suspension system 14 bends such] -- or by the ability twisting, the head slider assembly 12 will swerve from the meant location about a desired truck. Since the head suspension system assembly 10 must be driven at a high rate by high engine-performance desk drive, the resonance frequency of a suspension system must be high as much as possible.

[0012] The volume of the spring field 24 of the suspension system 14 sometimes generally called the radial configuration of a suspension system or an outline or the location of bending, a configuration, and a dimension may influence the resonance characteristic sharply as indicated by the U.S. Pat. No. 5,471,734 number by a hatch way etc. So, the radial configuration of a suspension system must be correctly controlled during manufacture, in order to make the resonance characteristic of the component the optimal. The radial configuration of a suspension system has described the description of the parameter called a bias and upheaval by patent of a hatch way etc. However, dividing the radial configuration of a suspension system using various parameters is known. As an example, HATCHINSON Technology, Incorporated which is the grantee of this application often describes the description of the radial configuration of a slider assembly like 14 using the parameter of a large number containing the parameter called "height" and the "depth", or a "ripple." As shown in drawing 4 , the parameter of height is spacing of z height between the front face of the load beam 16 in the attachment field 18, and the point of the hard field 26. The location on the hard field 26 where height is measured is related to the end face of the load beam 16 with the spacing parameter called a "height location." The depth is spacing of z height between the front faces of the load beam 16 and the points of the spring field 24 in the attachment field 18. The location on the spring field 24 where the depth is measured is related to the end face of the load beam 16 with the spacing parameter called "the location of a low point." Typically, a low point location is a location which has the depth in the max about a suspension system 14.

[0013] The criteria relevant to another important engine performance of a suspension system 14 are known as the static posture. The posture of the head slider assembly 12 relates to the location orientation of a slider assembly about the field of a desk to which the slider assembly is flying the upper part. The head slider assembly 12 is designed so that it may fly in the field of a desk, and predetermined orientation (typical almost in parallel). The deviation from this parallel relation for the first transition and the trailing edge of a slider to become what is been in various height (namely, surrounding rotation of the y-axis which crosses the longitudinal direction x axis of a suspension system) from a desk is known as a pitch error. That is, the deviation from parallel relation for the side which a slider counters to become what is been in various height (surrounding rotation of the longitudinal direction x axis of a suspension system) from a desk is known as a volume error. The pitch or volume error in a premature start posture of a request of a slider may make the engine performance of a desk drive fall.

[0014] One source of these pitches and volume errors is the static posture error of a suspension system. Use of the static posture compensation impression for making static posture errors and these errors as small as possible or upheaval is indicated by the paper of Harrison and others it is [the effect about a duplex impression magnetic-recording head suspension system and fly height variability] entitled.

[0015] The need for the equipment and the approach of adjusting the improved head suspension system remains continuously. Especially, there are a gram load, height or an outline property, and the equipment for winding and/or adjusting a suspension system parameter like a pitch and the need for an approach. Especially the equipment and the approach for adjusting some of these parameters are desirable. Since it can perform commercially, such equipment and an approach must be able to attain an advanced precision and repeatable nature.

[0016]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing. On the whole, the suspension system adjusting device 100 which is the gestalt of operation of the first of this invention is shown in drawing 5 . Equipment 100 rolls an almost even (that is, not wound yet) suspension system, and carries out gram load adjustment. As mentioned above in the preceding paragraph of this invention, the suspension system of these formats is already fabricated and is attached in the carrier strip in this manufacture phase of a suspension system. So, in relation to the carrier strip 34 of a suspension system 14 like the carrier strip which the publication next to equipment 100 (and equipments 200,700 and 900 described below) mentioned above, it is stated for the purpose of an example. However, by rolling each suspension system like 14 which is not attached in a carrier strip like 34, equipment 100 can also be used in order to carry out gram load adjustment. furthermore, equipment 100 can use a head gin PAL assembly like 10 in order [or] to carry out gram load adjustment, and to readjust or [namely, / adjusting a gram load, after a head slider assembly like 12 is combined with a suspension system].

[0017] Like illustration, it has a walking beam 101, and this walking beam advances the carrier strip 34 (it is not visible to drawing 5) through equipment, and equipment 100 rolls each suspension system 14 succeedingly, and positions it to a station 102, the first g load measurement station 104, the gram load aligner station 106, the second g load measurement station 108, and a design use external article dee tab station (not shown). At the volume station 102, it is wound around the surroundings of the mandril with which the spring field 24 of a suspension system 14 curved, or it is bent by other methods, and a desired radial configuration is given to a suspension system. At the first gram load measurement station 104, a suspension system 14 is lifted to fly height, and the postvolume fly height gram load of a suspension system is measured. the specification design of a request of the postvolume gram load measured at the station 104 so that it might state to a detail below -- if out of range, in order to adjust the gram load of a suspension system 14 like a gram load adjustment fault, it will be carried out at a station 106. The postadjustment gram load of a suspension system 14 is measured at the second gram load measurement station 108. the design specification of a request of the postadjustment gram load of a suspension system 14 -- if out of range, a suspension system will be refused and it will be cut from a carrier strip at a design out-of-specification dee tab station. And the suspension system 14 within the design specification which remains is removed from equipment 100, and is conveyed to pure heat treatment and a purification station (not shown). Following purification, heat treatment, and purification actuation, a suspension system is conveyed to the last dee tab station, and all the remaining suspension systems 14 are cut from the carrier strip 34, and it is packed there in order to convey to a customer succeedingly. With the gestalt of other operations, a suspension system 14 is not heat-treated following adjustment of the suspension system of equipment 100.

[0018] A walking beam 101 can be what kind of common use for conveying and positioning a suspension system 14 at stations 102, 104, 106, and 108, or the device of other common knowledge. By the example, such one walking-beam device is U.S. Pat. No. 4,603,567 of Smith and others. It is indicated. A walking beam 101 and stations 102, 104, 106, and 108 are attached in the base 103.

[0019] The volume station 102 can be what kind of common use for bending the spring field 24 of a suspension system 14 for a desired outline, or the device of other common knowledge. A volume station like 102 is mostly known by the U.S. Pat. No. 5,371,734 number by the U.S. Pat. No. 4,603,567 number by Smith etc., a hatch way, etc., and is indicated. In short, it has the stepper motor 114 shown in drawing 1 for the gestalt of operation of a station 102 to make it go up and down a base clamp and the radial block device 110, the radial block slide 112, and a roller (for it not to be visible) by winding. After each suspension system 14 winds by the walking beam 101 and moves forward to a station 102, a base clamp and the radial block device 110 clamp the substrate 21 of a suspension system functionally at the base, where the spring field 24 is located under the curved mandril (this is not visible, either). The curved mandril has the outline which gives a desired outline to the spring field of a suspension system. And a stepper motor 114 acts and it winds, and through a stroke, a roller is raised, and is driven, a roller engages with the spring field 24 on a mandril during a volume stroke, and this is rolled. The range (namely, the die length of a volume stroke) around which a spring field is

wound on a mandril affects the gram load of a suspension system 14. With the gestalt of 1 operation of equipment 100, as for the volume station 102, only the fixed specified quantity rolls each suspension system 14. Using the interface terminal of a device control system (not shown), an operator winds so that a desired postvolume gram load (typically percent of a desired nominal gram load) may be attained to the suspension system 14 which appears from the volume station 102, and he sets up a station 102. The radial block slide 112 can adjust the location of the mandril about a base clamp, and the location of the roll on the spring field 24 which is the parameter which so affects the resonance characteristic of a suspension system. Following a volume process, a base clamp is opened, and a suspension system 14 is released, and a walking beam 101 conveys a suspension system to the first measurement station 104 succeedingly.

[0020] The first and second gram load measurement stations 104 and 108 can be other common use for measuring the gram load of a suspension system 14 in fly height, or the device of other common knowledge, respectively. Such one gram load measurement station is U.S. Pat. No. 4,603,567 of for example, Smith and others. It is indicated. The gestalt of operation of the measurement station 104 shown in drawing 5 has a load cell 120, an elevator 122, the elevator actuator 124, a stepper motor 126, and the base clamp 128. The measurement station 108 can be the same as that of a stepper motor 104, and the same reference mark to which the deer was carried out and the subscript was attached has shown the same description (namely, "x'").

[0021] If it says simply and a suspension system 14 will move forward to the measurement station 104 by the walking beam 101, the base clamp 128 will clamp firmly the load beam 16 and flection 20 of a suspension system functionally based on the substrate 21 of a suspension system (it is not visible) in the condition that you made it located under a load cell 120 and an elevator 122. And a stepper motor 126 acts, it is made to descend to an extended location (shown in drawing 6 B) from the location from which the load cell 120 and the elevator 122 were withdrawn into coincidence, and a load cell is located in relative z height measuring point in the extended location about the base equal to the design-specification fly height of a suspension system 14. As shown in drawing 6 A, only distance with a larger elevator 122 than a load cell 120 is prolonged below in the retreating location. When a load cell 120 and an elevator 122 descend, so, an elevator engages with a suspension system 14 before a load cell (in location on the hard field 26 which adjoins a flection 20 typically), and a suspension system is raised to z height exceeding fly height. After dropping a load cell 120 to a fly height location, the elevator actuator 124 is made to act, and an elevator 122 is raised, and the flection 20 of a suspension system 14 is calmly positioned to a load cell (shown in drawing 6 C) for gram load measurement. And this process is repeated by the reverse order and a suspension system 14 is returned to that free condition. Excluding [instead] an elevator 122 and the elevator actuator 124, the gestalt of other operations of the measurement stations 104 and 108 (not shown) uses a load cell 120 in order to raise a suspension system to a fly height measuring point. Following a gram load measurement process, the base flection 128 can be opened, and a suspension system 14 can be released, and a walking beam 101 can be made to convey a suspension system to the following stepper motor.

[0022] The gram load aligner station 106 is stated to a detail with reference to drawing 5 , and 7-10. Like illustration, a station 106 has the clamp assembly 130, a stepper motor 132, and the suspension system positioning assembly 134. The clamp assembly 132 has the fixed base 136 and the migration clamp member 138. The base 136 is firmly attached about a walking beam 101, and it has ************ so that the substrate 21 of a suspension system 14 may be received and adjusted. The clamp member 138 is driven so that it may go back and forth between closing and open positions about the base 136 synchronizing with actuation of a walking beam 101. First like a gram adjustment fault, the clamp member 138 is in the open position (not shown) in which spacing was kept from the base 136. And a walking beam 101 advances a suspension system 14, and is adjusted in the clamp assembly 130. After a substrate 21 is adjusted by the base 136 and the straight line by the walking beam 101, it drives to the closing location which showed the clamp member 138 to drawing 7 , and a substrate 21 is functionally clamped to the base 136. In that case, the attachment field 18 of a suspension system 14 is clamped functionally, and a gram adjustment fault holds it firmly to the inside aligner station 106. Following the completion like a gram adjustment fault, the clamp member 138 can be driven to the open position, and a suspension system 14 can be released, and a suspension system can be advanced from a station 106 by the walking beam 101.

[0023] The stepper motor 132 and the suspension system positioning assembly 134 are attached in the fixed base 140. The stepper motor 132 is attached in the upper part of the base 140 at the fixed condition. The suspension system positioning assembly 134 has the slide mounting 142, the support arm 144, and the positioning bar assembly 146. the direction which can bend the suspension system 14 which clamped the slide mounting 142 around the spring field 24 (to for example, surroundings of the ******** z-axis perpendicular in the example of illustration) -- **** -- it is attached in the base 140 possible [reciprocation in an parallel direction]. The support arm 144 was attached in the slide mounting 142, and is prolonged from there. The positioning bar assembly 146 is attached in the edge of the support arm 144 which counters the slide mounting 142, and the clamp assembly 130 is adjoined and it is located. A stepper motor 132 is

connected with the slide mounting 142, and slide mounting is driven through the both-way operating range.
[0024] The positioning bar assembly 146 has the plate 148 of the about C forms where spacing of a pair was kept, and these plates have the gap 150 which extends in the longitudinal direction opened toward the clamp assembly 130. The upper part positioning bar 152 is horizontally prolonged in between the plates 148 above a gap 150. Similarly, the lower part positioning bar 154 is horizontally prolonged in between Shimo's plates 148 from the gap 150 and the bar 152. Bars 152 and 154 are located in an assembly 146 in the location of the upper and lower sides of the end of the load beam 16 of the suspension system 14 which was clamped by the clamp assembly 130 and has been prolonged from the clamp assembly. The positioning bar assembly 146 is shown in drawing 7 in the suspension system clamp location. In this suspension system clamp location, the gap 150 is adjusted with the clamp assembly 130, and it can move forward so that a suspension system 14 may be approached and isolated with a clamp assembly in the condition that the load beam 16 is prolonged in between bars 152 and 154.
[0025] The optical-fiber bracket 156 adjoins the base 136 of the clamp assembly 130, and is attached in the fixed condition. A bracket 156 is ************** so that one or more optical fibers 158 in the condition that the edge 160 of a fiber was positioned in the location immediately on the spring field 24 of the suspension system 14 clamped by the clamp assembly 130 may be received and held. Laser 177 or other infrared light sources (shown in drawing 9) are connected with the opposite edge of an optical fiber 158. The gestalt of operation of the station 106 of illustration has two optical fibers 158, and these optical fibers are attached in the bracket 156 so that it may be located above the leg in which those edges 160 kept spacing of the spring field 24. Generally, the edge 160 of a fiber 158 is located so that the infrared radiation (namely, heat) of strength comparatively uniform above the spring field 24 of a suspension system 14 may be turned. the gestalt of 1 operation of this invention -- a laser 177 sake -- SDL of San Jose of California from -- the purchased 10W laser diode is used.
[0026] The control system 170 for controlling actuation of the gram load aligner station 106 is shown in drawing 9 . Like illustration, a control system 170 has the digital processor connected to program memory 174 and the interface terminal 176. The processor 172 has interfaced with stepper motor 126' of the stepper motor 132 of the stepper motor 124 of the volume station 102, the stepper motor 126 of the gram load measurement station 104, the elevator actuator 124, a load cell 120, and the gram load aligner station 106, laser 177, and the gram load measurement station 108, elevator actuator 124', and load cell 120' again. In order to carry out like a gram load adjustment fault, the gram adjustment program carried out by the processor 172 is memorized by memory 174. The interface terminal 176 which has a monitor and a keypad (not shown separately) is used by the operator, in order to set up equipment 100 during production and to supervise actuation of equipment.
[0027] or [raising the load beam 16 to a position to the spring field 24 of a suspension system 14 like a gram load adjustment fault from the (are it desirable to raise the gram load of a suspension system or to lower or not? therefore) free condition] -- or stress is applied by making it descend, if it becomes And in order to ease stress by overheating a spring field, holding a load beam to a position (for example, thing for which an infrared laser beam is applied) It is based on discovery that the gram load of a suspension system can be adjusted to an advanced precision, repeatable nature, and stability in prediction. Before stress is eased, it is dependent on the amount of the stress which the spring field 24 receives, and the magnitude of the gram gravity dependent opacity generated according to this process can control this stress level by the location of the load beam 16 about that free condition location.
[0028] Therefore, the adjustment data which express desired fly height gram gravity dependent opacity according to a load beam adjustment position are memorized by memory 174. A load beam adjustment position is a location which the load beam 16 of a suspension system 14 drives upwards with a bar 154, and drives from the free condition location below with a bar 152. With the gestalt of desirable operation, adjustment data are characterized by the gram gravity dependent opacity which draws linearity equality according to a load beam adjustment position. A load beam adjustment position can make it relate mutually to the number of the step motors 132 which must be driven so that the positioning bar assembly 146 may be gone up or dropped from the clamp location and bars 154 and 152 may be positioned to a desired load beam adjustment position. Moreover, the data showing nominal rating of a suspension system 14 or a desired gram load are memorized by memory 174.
[0029] Drawing 10 is a flow diagram which shows like the gram load adjustment fault performed by the station 106. Like the adjustment fault, while receiving data from the first gram load measurement station 104 showing the postvolume gram load of the suspension system 14 which should carry out gram load adjustment, it starts (step 180). And the difference between the postvolume gram loads and the nominal gram loads which were measured is calculated, and desired gram gravity dependent opacity (namely, amount of the gram load adjustment which should be made by the station 106) is determined (step 182). And a processor 172 accesses adjustment data according to desired gram gravity dependent opacity, and determines the load beam adjustment position which generates desired gram gravity dependent

opacity. In the gestalt of the above-mentioned operation whose adjustment data are linearity equality, a processor 172 calculates a load beam adjustment position about the number of the required steps to which a motor 176 must be driven, and the positioning bar assembly 146 must be gone up or dropped (step 184). And a stepper motor 132 is made to act by the processor 172 so that it may position to the adjustment position which drives the positioning bar assembly 146 and one of bars 152 had the load beam 16 calculated (step 186). Where the load beam 16 is held to the adjustment position, a processor 172 makes the laser 177 between the exposure times act, and stress relaxation is heated and carried out by applying the infrared radiation turned to the spring field through the optical fiber 158 (step 188). In order to complete like an adjustment fault, a processor 172 turns OFF laser 177 at the end of the exposure time, make it a suspension system 14 get cold in ambient temperature (it is usually enough in 1 or less second) (step 190), a motor 132 is made to act again after that, the positioning bar assembly 146 is driven, and it returns to a clamp location (step 192).
[0030] An operator sets up a control system 170 using the interface terminal 176. With the gestalt of one operation, it sets up by observing the physical effect of the infrared radiation which exerts the exposure period of laser 177 on the test suspension system 14. An exposure period is made to increase during an exposure trial especially until it is fully large although the heat applied oxidizes a suspension system 14, and the "Browning" effectiveness will be exerted on a suspension system. This process is known as what determines the Browning threshold. An exposure period is then set as the period which is predetermined time amount (for example, 50 msec.) smaller than the Browning threshold. Thus, according to the set-up process, the spring field 24 in an exposure period will be heated by the temperature between about 600 degrees - 900 degrees F (315 degrees - 482 degrees C).
[0031] Gram load adjustment data (for example, linearity equality multiplier for the gestalt of the above-mentioned desirable operation) are first established in the setting process in which some suspension systems 14 which have a known (measured at the first gram load measurement station 104) postvolume gram load drive to various setting adjustment positions, and stress relaxation is carried out by the aligner station 106. And change of the gram load which measured the postadjustment gram load of a suspension system 14 at the second gram load measurement station 108, and was caused by the processor 172 by the aligner station 106 by these setting adjustment positions using it is calculated. And a processor 172 produces gram load adjustment data by calculating the minimum square fit (for example, the Gaussian method) to the gram gravity dependent opacity and the corresponding setting adjustment position which were measured. Similarly, adjustment data can be updated periodically or continuously by the processor 172 in normal operation of an aligner station 106 based on the difference by which it was measured between the actual postadjustment gram load and the nominal gram load.
[0032] On the whole, the suspension system adjusting device 200 which is the gestalt of operation of the second of this invention is shown in drawing 11 . Equipment 200 rolls an almost even (that is, not wound yet) suspension system, and adjusts a gram load, a radial configuration, and a static posture (both a pitch and a volume). As stated to the preceding paragraph of this invention, as for the suspension system of these formats, it is typical for it to already be fabricated and to be attached in a carrier strip in those manufacture phases of these. So, the publication next to equipment 200 is given in relation to the carrier strip 34 of the suspension system 14 which was mentioned above for the example. The part of equipment 200 is the same as the part of the equipment 100 mentioned above, and these parts are described using the reference figure which attached the subscript (namely, "x"") of two times, although it is the same.
[0033] Like illustration, the suspension system adjusting device 200 has walking-beam 101" which advances the carrier strip 34 (it is not visible to drawing 1) through equipment. Walking-beam 101", each suspension system 14 is succeedingly positioned to volume station 102", the reverse bending station 202, a gram load and the outline measurement station 204, quiescence posture measurement and the pitch aligner station 206, the laser aligner station 208 and the quiescence posture measurement station 210, and the dee tab station outside design use (not shown).
[0034] In volume station 102', the substrate 21 of a suspension system 14 is clamped by a base clamp and 110" of radial block devices, and it is wound around the surroundings of the mandril with which the spring field 24 curved, bends for the outline of a request of a spring field, and a desired postvolume gram load is given to a suspension system. If a volume activity is completed, a suspension system 14 is released from device 110', and is conveyed to the reverse bending station 202, a suspension system will be bent to hard flow and only the specified quantity will decrease that gram load at this station (that is, only the specified quantity is bent across that elastic-deformation range to the direction and opposite direction which rolled the suspension system).
[0035] Common use or the reverse bending device of other common knowledge is incorporable into a station 202. A load cell is not included although the reverse bending station 202 is structurally similar with the gestalt of operation shown in drawing 11 with the gram load measurement station 104 mentioned above in relation to the adjusting device 100. Like illustration, the reverse bending station 202 has an elevator 222, the elevator actuator 224, a stepper motor 226, and the base clamp 228. If a suspension system 14 is advanced to the reverse bending station 202 by walking-beam

101", the base clamp 228 clamps the substrate 21 of a station functionally at the base (it is not visible), and the load beam 16 and flection 20 of a suspension system are located below an elevator in that case. And a stepper motor 226 is made to act and an elevator 222 is driven through a reverse bending stroke by dropping an elevator to an extended location from the retreating location. When an elevator 222 drives to an extended location, an elevator 222 is engaged at a suspension system 14 (in location on the hard field 26 which adjoins a flection 20 typically), and the direction and opposite direction around which the suspension system was wound are raised. or [the load beam 16 being raised across the range of elastic deformation, and bending the spring (or / namely, / that a load beam will change "springback" into the free condition of the origin of it if released from an elevator / -- or returning point -- exceeding) field 24 during reverse bending actuation,] -- or plastic deformation is carried out and this gram load at that time is decreased. Reduction of the amount of the plastic deformation given to the load beam 16 during reverse bending actuation and the gram load so caused is controlled by extent to which reverse bending of the load beam is carried out (namely, the die length of a reverse bending stroke of an elevator 222). With the gestalt of 1 operation of an adjusting device 200, the reverse bending stroke 202 carries out reverse bending of each suspension system 14 only for the specified quantity (0.3g [as opposed to / For example, / the suspension system which has 2 or a 5g nominal gram load]). In order to attain the postreverse volume gram load of a request of the suspension system 14 with which an operator appears from a reverse bending stroke using an interface terminal (drawing 25), the reverse bending station 202 is set up. Following a reverse bending process, the base clamp 228 can be opened wide, and a suspension system 14 can be released, and walking-beam 101" can convey a suspension system to the next station.

[0036] A gram load and the outline measurement station 204 have the gram load measurement machine 230 and z height measurement machine 232. Although the gram load measurement machine 230 is structurally similar with the gram load measurement station 104 mentioned above about the adjusting device 100, it does not have an elevator or an elevator actuator. Like illustration, the gram load measurement machine 230 has a load cell 234, a stepper motor 236, and the base clamp 238. After advancing a suspension system 14 to a station 204 by walking-beam 101", the base clamp 238 clamps the base 21 of a suspension system functionally at the base (it is not visible), where the load beam 16 and flection 20 of a suspension system are located below a load cell 234. And a stepper motor 226 is made to act, a load cell 234 is driven so that it may engage with a flection 20, and a suspension system 14 is raised in the design-specification fly height. And the measured value of the postreverse bending gram load of a suspension system 14 can be given by the load cell 234.

[0037] It is positioned so that the height parameter of the suspension system 14 clamped by the base clamp 238 may be measured, and z height measurement machine 232 is **************. As stated to the preceding paragraph of a specification, the high parameter of a suspension system 14 can be used in order to draw the outline configuration of a suspension system, therefore the resonance characteristic of a suspension system. the gestalt of implementation of illustration -- a machine 232 -- between the base clamp 238 and load cells 234 -- and it is the optical point range sensor attached above the suspension system 14 clamped by the base clamp at the station 204. Generally it is known and an optical point range sensor is Arizona. Tucson It can obtain from the feeder of a large number including a WYKO corporation in a commercial scene. In short, the point range sensor of this format produces the light beam turned at the include angle which is not perpendicular to a measurement target. Then, it reflects from a target and this light beam is turned to a detector. The location where the reflected light beam runs against a detector changes according to the distance between a machine 232 and a measurement target. At the station 204, the machine 232 is located so that a light beam may be turned to the location on the hard field 26 of the suspension system 14 which must measure a high parameter. And z height measurement machine 232 can give the high parameter measured value of a suspension system 14, when a suspension system is lifted to fly height by the load cell 234. Although not illustrated, a station 204 can contain the measurement machine which replaces it for measuring the high parameter of a suspension system 14. Furthermore, since the outline configuration of a suspension system 14 is characterized, the additional parameter to height which it reaches and is replaced with/or it can be used.

[0038] After measuring the gram load and height parameter of a suspension system 14, a stepper motor 236 is made to act, and a load cell 234 is raised to the retreating location, and a suspension system 14 is returned to the free condition. The base clamp 238 can be opened wide, and a suspension system 14 can be released, and walking-beam 101" can convey a suspension system to the next station.

[0039] Quiescence posture measurement and the pitch aligner station 206 have the suspension system clamp assembly 240, the pitch adjustment device 242, and the quiescence posture measurement machine 244. After advancing a suspension system 14 to a station 206 by walking-beam 101", the clamp assembly 240 is made to act and it drives from that open position to a substrate clamp location, and the substrate 21 of a suspension system is clamped functionally and a suspension system is raised to fly height in this substrate clamp location. And the quiescence posture (at the gestalt of

implementation of illustration, they are both a pitch and a volume) of a flection 20 is measured by the machine 244. After a quiescence posture is measured, the clamp assembly 240 acts again and it drives from a substrate clamp location to a load beam clamp location. In a load beam clamp location, the clamp assembly 240 carries out the fixed clamp of the hard field 26 of the load beam 16. And it acts so that the pitch adjustment device 242 may engage with a flection 20 and the pitch may be adjusted. The clamp assembly 240 can be wide opened like these quiescence posture measurement and a pitch adjustment fault, and a suspension system 14 can be released, and walking-beam 101" can convey a suspension system to the next station. It is ************* so that the pitch adjustment device 242 may include pitch change, and it may engage with the end of the load beam 16 and may bend with the gestalt (not shown) of other operations.

[0040] As shown in drawing 12 , and 13A-13C on the whole, the suspension system clamp assembly 240 has the base assembly 246, the substrate clamp assembly 248, and the load beam clamp assembly 250. The base assembly 246 can be stated to a detail about drawing 14 -16, and has the base 252 and the fly height adjustment stopper assembly 254. The base 252 is a machined member with a top face which has the clamp assembly guidance field 256, the substrate clamp field 258, and the load beam clamp field 260. The long and slender slot 262 has extended into the clamp assembly guidance field 256. A slot 262 has the bearing slot 266 of the hemicycle of the pair which crossed the slot in the inferior surface of tongue 264 which inclines caudad from a clamp field, and the location in which spacing was kept as a longitudinal direction axis almost parallel to the axis prolonged through the clamp fields 258 and 260 and distance increased, and has been prolonged. The fly height adjustment stopper assembly 254 has the roller bearing 268, the stopper block 270, the spring 272, and the height adjustment control section 274 of the pair attached in the bearing slot 266. The stopper block 270 has the central opening 280 prolonged in between the inferior surface of tongue 276 almost parallel to the inferior surface of tongue 264 of a slot 262, the top face 278 almost parallel to the field of the clamp assembly guidance field 256 and a top face, and inferior surfaces of tongue. The inferior surface of tongue 276 of the stopper block 270 is located on the roller bearing 268, can slide on the inside of the stopper block fang furrow 262, and can change the location (namely, height on top) of a top face 278 about the field of the base 252 by it. The lower limit of a spring 272 is hung on the surroundings of the pin 282 attached in the base 252. The upper limit of a spring 272 is prolonged through opening 280, and is hung on the surroundings of the pin 284 attached in the stopper block 270. So, the spring 272 is energizing the stopper block 270 in the direction which keeps away from the clamp fields 258 and 260. The height adjustment control block 274 has the attachment member 286, the insertion 288 with ****, the rod 290 with ****, and a knob 292. The attachment member 286 has the hole 294 which adjoined the location as for which a slot 262 carries out opening, and was located in the backside of the base 252, and was adjusted with the slot. The insertion 288 with a screw thread is attached in the hole 295. A shaft 290 has the stopper edge 295 which was attached by **** in the insertion 288, and has extended into the slot 262. Thereby, a shaft 290 restricts actuation of the stopper block 270 in a slot 262. So, the height of the top face 278 of the stopper block 270 can be adjusted and set up by rotating a shaft 290 using a knob 292.

[0041] The substrate clamp field 258 of the base 252 and the load beam clamp field 260 are stated to a detail with reference to drawing 14 , and 16 and 17. The substrate clamp field 260 has the guidance upheaval 304 between the side faces of the substrate clamp pad 300, the guidance pad 302 of the opposite side of a clamp pad and a guidance pad, and the base 252. the substrate clamp pad 300 is raised from the perimeter part of the base 252, and receives the substrate 21 of a suspension system 14 -- as -- ***************** -- it has a flat top face. The guidance pad 300 has the field which inclines upwards toward the clamp pad 300, in order to guide the substrate 21 of the suspension system 14 which attains to a clamp pad by walking-beam 101", and is moving forward from the clamp pad. Similarly, the guidance upheaval 304 has the field which inclines upwards toward the clamp pad 300, in order to guide the suspension system 14 which attains to a clamp pad and is moving forward from the clamp pad.

[0042] The dimension arrangement is carried out so that the attachment boss 23 of the suspension system 14 which the adjustment hole 306 is prolonged into the clamp pad 300, and was clamped by the clamp pad may be accepted. It is equipped with a rod 308 possible [a reciprocating motion] in a hole 306, and is energized upwards with the spring assembly object 310. With the gestalt of implementation of illustration, the spring assembly object 310 has springs 312 and 314 and a plunger 316, and these **** and are held by 320 from the hole 306 at Shimo's hole 318. A spring 314 is ****ed and is located between 320 and a plunger 316. The spring 312 is located between a plunger 316 and a rod 308. it was shown in drawing 17 -- as -- the spring assembly object 310 -- the -- that is [it is not compressed], it is in a free condition, and with the top face of the clamp pad 300, the top face of a rod 308 is ********(ed) and located in a hole 318 so that it may be the same flat surface mostly. When the substrate 21 of a suspension system 14 is clamped by the clamp pad 300 with the substrate clamp assembly 248, a mounting hole 23 extends into a hole 306, and a suspension system is correctly positioned on a clamp pad. This actuation pushes aside a rod 308 below and compresses springs 312 and 314. The substrate 21 of a suspension system 14 is succeedingly released with the substrate clamp assembly 248,

the spring assembly object 310 can push aside a rod 306 upwards, the attachment boss 23 can be raised from a hole 306 by that cause, and a suspension system can be advanced from the clamp pad 300 by walking-beam 101".

[0043] The load beam clamp field 260 has the guidance pad 324 of the pair located in the opposite side of the clamp side 322 and a clamp side. The guidance pad 324 has the field which inclines upwards toward the clamp side 322, in order to show the hard field 26 of the suspension system 14 which reaches a clamp side by walking-beam 101", and is moving forward from a clamp side. The clamp side 322 is taken back from the field of the guidance pad 324, and has a hole 326. As shown in drawing 17 , the hole 326 is prolonged into the hole 330 of a bigger path with the shoulder block 328. The inside of a hole 326 and 330 is equipped with a rod 334 and the plunger 32 which has a piston 336 possible [reciprocation], and it is energized upwards with the spring assembly object 338. The spring assembly object 338 has a spring 340, a washer 342, and **** 344. The spring 340 is held in the state of compression in the hole 330, and was pushed aside upwards to the extended location which showed the plunger 332 to drawing 17 , and the piston 336 engaged with the shoulder 328 in the extended location, and the rod 334 is prolonged from the hole 326 to the height above a clamp side. If the hard field 26 of a suspension system 14 is clamped by the clamp side 322 with the load beam clamp assembly 250, the plunger rod 334 will be pushed in by the hard field of a suspension system into a hole 326. If the hard field 26 of a suspension system 14 is succeedingly released with the load beam clamp assembly 250, the spring assembly object 338 can push aside a plunger 332 upwards, the hard field of a suspension system can be raised from the clamp side 322 by that cause, and a suspension system can be advanced by walking-beam 101'.

[0044] The substrate clamp assembly 248 and the load beam clamp assembly 250 are described in the gross with reference to drawing 12 , 13A-13C, 14 and 15, and 18-22. The substrate clamp assembly 248 has the support frame 350, the clamp frame assembly 352, and an air press actuator 354. The support frame 350 has the transverse member 358 supported by the side member 356 and side member by which supported both the substrate clamp assembly 248 and the load beam clamp assembly 250 above the base assembly 246, and orientation was carried out to the perpendicular of a pair. It has the actuator arm 360 which the actuator 354 was attached in the top face of a transverse member 358, and has been prolonged through the hole (it is not visible) of a transverse member. The clamp frame assembly 352 has the frame plate 362, York 364, the elevator assembly 366, the guidance shaft 368, and the clamp pad assembly 370. It has the slot 374 by which the dimension arrangement was carried out so that York 364 might ****, and it might be attached in the top face of the frame plate 362 by 372 and a rod 376 might be received. To the upper limit of a rod 376 being bound tight by the actuator arm 360 with the nut 378, the lower limit of a rod is bound tight by York 364 with rings 380 and 382, and these rings are prolonged from the rod in the location of the upper and lower sides of York, and are engaging with the rod.

[0045] the bearing 384 of a line that the guidance shaft 368 is prolonged [and] from the inferior surface of tongue of the frame plate 362 -- reciprocation -- possible -- being located -- **** -- these lines -- it is equipped with bearing in the hole 386 of the base 252. With the gestalt of implementation of illustration, one guidance shaft 362 is located in the center at the ligula 388 prolonged from before a frame plate to being located in the side to which two guidance shafts 368 counter behind the frame plate 362. The long and slender upheaval 390 which kept spacing of a pair is prolonged from the inferior surface of tongue around the frame plate 362 to the lower part. As shown in drawing 18 probably best, upheaval 390 is prolonged in between the sides which the frame plate 362 counters, and one side of upheaval is located between the guidance shafts 368 of a pair in the regions of back of a frame plate in that case, and another side is located behind a ligula 388. the guidance shaft 368 -- a line -- it has two incomes with bearing 384, and other components of the frame plate 362 and the clamp frame assembly 352 are guided through the substrate clamp stroke which reciprocates.

[0046] The clamp pad assembly 370 is described with reference to drawing 23 A and 23B. Like illustration, the clamp pad assembly 370 is attached in ** 392 located in the center in front of the ligula 388 of the frame plate 362. ** 392 has the circular cross section, and has the upper part part 393 and the diameter lower part part 395 which decreased, and these are separated by the shoulder 397. The clamp pad assembly 370 has an outer tube 394, an inner tube 396, a spring 398, the jewel ring 400, and the clamp pad 402. The outside ring 394 has the lip 406 prolonged to the inside in the location in which it has the lip 404 with which this alignment is equipped possible [reciprocation in the lower part of ** 392] and, which is prolonged to the method of outside in the upper limit, and spacing was kept from the lower limit. The lip 404 is prolonged into the upper part 393 of ** 392, and engages with a shoulder 397, and restricts downward movement of an outer tube 394. An inner tube 396 has the lip 408 with which it is equipped in an outer tube 394 and which is prolonged to the method of outside in the margo inferior. an inner tube 396 -- the lip 408 -- the inside of an outer tube 394 -- and it is located below the lip 406 prolonged to the inside of an outer tube. When the lip 408 of an inner tube engages with the lip 406 of an outer tube 394, upward movement of an inner tube 396 is restricted. The spring 398 is prolonged in between the lip 406 with which this alignment is equipped around an inner tube 396 and which is prolonged to the inside of an outer tube 394, and the covering plates 410. The covering plate 410 is ****ed and

is being fixed to the frame plate 362 by 412 (drawing 19). The spring 398 is energized to the extended location which showed tubing 394 and 396 and the clamp pad 402 to drawing 18 and 23A, and the margo inferior of tubing 394 has projected it in this extended location more below than the inferior surface of tongue of the frame plate 362.

[0047] The clamp pad 402 has the clamp ball 414, the attachment pin 416, and a nut 420. The clamp ball 414 is a semi-sphere member which has an even clamp side. The pin 416 was attached in the semi-sphere side of the clamp ball 414 in the state of immobilization, and is prolonged into the inner tube 396 upwards through the ring 400. The nut 420 was bound tight by the edge of a pin 416, the pin was held to the inner tube 396, the semi-sphere side of the clamp ball 414 engaged with the ring 400 at that time, and the even clamp side has extended below the margo inferior of tubing 394. As shown in drawing 23 A and 23B, while the outer diameter of the attachment pin 416 is fully smaller than the bore of an inner tube 396 and the semi-sphere side of the clamp ball 414 rotates the inside of a ring 400 by it, a pin can rock the inside of tubing. While other components of a ring 400 and the clamp pad assembly 370 carry out fixed engagement with the clamp ball 414, when the suspension system is located in a clamp pad, the even clamp side of a clamp ball can be engaged with the attachment field 18 of the substrate clamp pad 300 (drawing 14) and the suspension system 14 lacking in a balance (for example, based on change of tolerance).

[0048] The gage pin 422 of the pair which has the margo inferior of a taper has projected from the inferior surface of tongue of the frame plate 362. a gage pin 422 -- the back of the clamp pad assembly 370 -- and the dimension arrangement is carried out so that it may be located in the side which counters and may extend into the hole 424 of the base 252 through the hole 35 of the carrier strip 34 (drawing 2).

[0049] The elevator assembly 366 is described as drawing 19 with reference to 22. Like illustration, an assembly 366 has a bracket 440 and the elevator pin 442. A bracket 440 is ****ed and is bound tight by 444 in the first transition of the frame plate ligula 388. the elevator pin 442 -- ****ing -- 446 -- the hole of a bracket 440 -- it was attached inside and has extended from the bracket to the lower part.

[0050] As shown in drawing 12 , 13A-13C, 14 and 15, and 18-22, the load beam clamp assembly 250 has the adjustment frame 450, the guidance shaft 452, and an air press actuator 454. A frame 450 is a member which has central opening and by which the ** form was mostly carried out to the rectangle. The clamp base 456 is attached before the frame 450. the line with which the guidance shaft 452 is prolonged from the inferior surface of tongue of a frame 450, and it was equipped in the hole 460 of the base 252 -- it is located possible [reciprocation] by bearing 458. The adjustment frame 450 has the crevice 462 in which it was located below the frame plate 362 of the clamp frame assembly 352, and spacing of the pair of the top face of both sides was kept. The guidance shaft 368 of the clamp frame assembly 352 is prolonged through central opening of the adjustment frame 450, and, thereby, the reciprocating motion of an adjustment frame is attained about a clamp frame assembly. The crevice 464 in which spacing of a pair was kept is located in the inferior surface of tongue of the both sides of the frame plate 362 of the clamp frame assembly 352 immediately on the crevice 462 of the adjustment frame 450.

[0051] an actuator 454 is attached between crevices 464 on the top face of the frame plate 362 of the clamp frame assembly 352 at it the side which counters -- having -- **** -- and a frame plate -- passing -- a lower part -- and it has the actuator arm 466 prolonged into the hole 468 of the adjustment frame 450. Each of an actuator arm 466 ****s and is being fixed to the adjustment frame 450 by 470. The spring 472 is attached in the crevices 462 and 464 related in order to energize the adjustment frame 450 from the frame plate 362 of the clamp frame assembly 352 to a lower part.

[0052] The clamp base 456 has the load beam clamp pad 474 and the guidance pad 476 in the side which a clamp pad counters. The load beam clamp pad 474 has the almost flat field which is raised from the perimeter part of the base 456, and has a feed hole 478. The flat field of the clamp pad 474 is ************** so that it may engage with the hard field 26 of a suspension system 14. The guidance pad 476 has the field which inclines toward the load beam clamp pad 474, in order to guide the load beam 16 of the suspension system 14 which attains to a clamp pad by walking-beam 101", and is moving forward from the clamp pad. drawing 13 A- as shown in 13C and 22, the hole 478 is prolonged through the load beam clamp pad 474 and the base 456, and it has consistency with the elevator pin 442. The clamp base 456 has a hole 480 in front of the load beam clamp pad 474. A hole 480 functions as a shutter for the light beam used in order to measure the static posture of the suspension system 14 clamped with the clamp assembly 240 so that it may mention later.

[0053] The quiescence posture measurement machine 244 is being fixed to the support frame 484 in the location immediately on the hole 480 of the clamp base 456. With the gestalt of implementation of illustration, a machine 244 is a collimator. The collimator is available in supply [some] origin which are generally known and contain WYKO of Sight Systems of Newburry Park of California, and Tucson of Arizona to a commercial scene. In short, the collimator of this format generates the light beam made the parallel turned to the measurement target. And it is reflected from a measurement target and a light beam is turned to a detector. The angle of incidence to which the reflected light beam

runs against a detector changes according to the orientation (namely, the include angle) of the front face of a target about a light beam. The machine 244 is located at the station 206 so that the light beam made parallel may be turned to the flection 20 of a suspension system 14 through a hole 480. And a machine 244 can give the measured value of the quiescence posture of a flection 20, when being raised with the substrate clamp assembly 248 to fly height by the method which a suspension system 14 mentions later. Although not illustrated, a station 206 can have the measurement machine which replaces it for measuring the quiescence posture of a flection 20.

[0054] The pitch adjustment device 242 has a stepper motor 488 and the flection bending assembly 490. As shown in drawing 11 , the stepper motor 488 is being fixed about base 103' which adjoins the suspension system clamp assembly 240. As shown in drawing 13 A - 13C, and 22 and 24, the bending assembly 490 has the arm 492 which it is attached in the stepper motor 488 and driven with a stepper motor. The member 494 of about C forms is located in the edge of an arm 492, and has the flection engagement pin 496 of a pair. The pin of another side is prolonged from the top face of a member to the lower part to one of the pins 496 being prolonged upwards from the inferior surface of tongue of a member 494. The flection bending assembly 490 is shown in the suspension system migration location of drawing 13 A. At this migration station, the gap between the edges of a pin 496 can be adjusted with the top face of a rod 334, is in the condition that the flection 20 is prolonged in between pins by that cause, and can pass through a suspension system 14 in the clamp assembly 240, and can be advanced from a clamp assembly.

[0055] On the whole, the control system 500 for controlling actuation of an adjusting device 200 is shown in drawing 25 . Like illustration, a control system 500 has the digital processor 502 connected to program memory 504 and the interface terminal 506. A processor 502 interfaces with the electric subsystem (namely, electric component) of each station 102", and 202, 204, 206, 208 and 210 again. especially -- a processor 502 -- the volume station electric subsystem 501 -- it rolled and has interfaced with the station electric subsystem 503, a gram load and the outline measurement station electric subsystem 505, quiescence posture measurement and the pitch aligner station electric subsystem 507, the laser aligner station electric subsystem 509, and the quiescence posture measurement station electric subsystem 511. Drawing 26 shows the electric subsystems 505 and 507 of a gram load, the outline measurement station 204, quiescence posture measurement, and the pitch aligner station 206 to a detail, respectively. Like illustration, the electric subsystem 505 of a gram load and the outline measurement station 204 has z height measurement machine 232, a load cell 234, and a stepper motor 236. The electric subsystem 507 of a quiescence posture and the pitch aligner station 206 has the quiescence posture measurement machine 244, a stepper motor 488, the substrate clamp pneumatic valve 508, and the load beam clamp pneumatic valve 510.

[0056] In order to carry out like quiescence posture measurement and a pitch adjustment fault, the quiescence posture adjustment program carried out by the processor 502 is memorized by memory 504. the substrate clamp valve 508 should pass a fixture (drawing 12) like 512, and a hose (not shown in drawing 12) like 514 in the source of the compressed air (not shown) -- it connects with an air press actuator 345. Similarly, the load beam clamp valve 510 connects the source of a compressed air with an air press actuator 454 through a fixture like 516, and a hose like 518.

[0057] Like the pitch adjustment fault, when only the specified quantity bends a flection to the upper part (namely, plastic deformation) or a lower part across the range of the elastic deformation about the hard field of the adjoining load beam 16, it is based on the knowledge that the pitch of the flection 20 of a suspension system 14 can be adjusted to an advanced precision, repeatable nature, and stability in prediction. It depends for the magnitude of change of the pitch generated according to this process on the distance or extent with which a flection 20 is bent at that plastic deformation within the limits.

[0058] Therefore, the suspension system adjustment data showing pitch angle change of the request according to a flection bending location are memorized by memory 504. a flection bending location -- the flection 20 (or load beam 16) of a suspension system 14 -- this location at that time to the pitch adjustment device 242 -- the upper part -- or it is the location driven below. A flection bending location can have an interrelation in the number of the steps which must drive a motor 488 so that the bending assembly 490 may be gone up or dropped from the clamp location and a pin 496 may be positioned in a desired bending location. Moreover, the data which express nominal rating of a flection 20 or a desired pitch with memory are also memorized.

[0059] Drawing 27 is a flow diagram which shows like the quiescence posture measurement performed by the station 206 and a pitch adjustment fault. A process starts the suspension system 14 which should be measured and which should reach and carry out pitch adjustment with migration to the suspension system clamp assembly 240, while a clamp assembly is in the suspension system migration location shown in drawing 13 A (step 510). It is made for a processor 502 to have the clamp assembly 240 in a suspension system migration location by making the substrate clamp valve 508 act so that it may drive up to the location which the air press actuator 354 retracted the actuator arm 360, and drew in the base clamp assembly 248. An air press actuator 454 retracts those actuator arms 466 to coincidence, and a processor 502

makes the load beam clamp valve 510 act on it so that the load beam clamp assembly 250 may be driven to the location from which it resisted and withdrew into the energization force of a spring 472 upwards. When it is in the location from which the substrate clamp assembly 248 withdrew, while the clamp pad assembly 370 is energized in the extended location shown in drawing 23 A, the spring assembly object 310 is energized to the extended location which showed the rod 308 in the substrate clamp field 258 on the base 252 to drawing 17 . When it is in the location from which the substrate clamp assembly 248 withdrew, the inferior surface of tongue of the substrate clamp assembly frame plate 362 and upheaval 390 have kept spacing from the top face of the substrate assembly stopper block 270. When the load beam clamp assembly 250 is in the retreating location, the elevator pin 442 is prolonged over the load beam clamp pad 474 through the hole 478. The spring assembly object 338 energizes a plunger 332 up to the extended location shown in drawing 17 in which a plunger 332 projects across the clamp side 322, when it is in the location from which the load beam clamp assembly 250 withdrew. As shown in drawing 13 A, when the clamp assembly 240 is in the retreating location, there is gap sufficient between the substrate clamp balls 414 and the substrate clamp pads 300 like the ability to pass through a suspension system 14 in a clamp assembly, and make it move forward from a clamp assembly and between the load beam clamp pad 474 and the load beam plunger 332.

[0060] After advancing the suspension system 14 which should measure or should ****** into the clamp assembly 240, a processor 502 makes the substrate clamp valve 508 act so that it may drive to the substrate clamp location which the air press actuator 354 extended the actuator arm 360, and showed the substrate clamp frame 352 below to drawing 13 B through the substrate clamp stroke (step 512). While only a larger distance than the clamp pad assembly 370 which a gage pin 422 has in the extended location is prolonged from the functional clamp assembly frame plate 362 to the lower part, therefore the substrate clamp frame assembly 352 is moving below, a gage pin goes into the hole 35 of the suspension system carrier strip 34, and alignment of the suspension system 14 is carried out above the substrate clamp pad 300. The even inferior surface of tongue of the clamp ball 414 engages with the attachment field 18 of a suspension system 14, the attachment boss 23 is pushed aside into the alignment hole 306, by that cause, the energization force of the spring assembly object 310 is resisted, and a rod 308 is pressed below, and the substrate 21 of a suspension system is energized, and the flat field of the substrate clamp pad 300 is made to contact with the actuation to the lower part which the clamp frame assembly 352 follows. If a clamp frame assembly still moves below further, within the frame plate 362, the energization force of a spring 398 will be resisted, the clamp pad assembly 370 will be pushed aside toward the retreating location, (drawing 23 B), and the attachment field 18 of a suspension system 14 will be certainly clamped to the substrate clamp pad 300 (namely, functional clamp) by it. By migration in this lower part, the elevator pin 442 engages with the hard field 26 of the load beam 16 again, and a load beam is raised from that free condition.

[0061] When the clamp frame assembly 352 is in a substrate clamp location, the upheaval 390 on the inferior surface of tongue of the substrate clamp assembly frame plate 362 engages with the top face of the substrate assembly stopper block 270. By adjusting the height of the stopper block 270 about the base 252, when the clamp frame assembly 352 is in a substrate clamp location about the location at the tip of the elevator pin 442, it can set up so that an elevator pin may drive a suspension system 14 in fly height.

[0062] After clamping the substrate 21 of a suspension system 14 functionally at the base 252 and raising a flection 20 in fly height, a processor 502 makes the quiescence posture measurement machine 244 act. The quiescence posture measurement machine 244 generates a light beam 514, and it is made to direct to up to the flection 20 of a suspension system, as shown in drawing 13 B. With the gestalt of implementation of illustration, when a light beam 514 passes along a hole 480, it is turned so that only the light reflected from the flection 20 of a suspension system 14 may return to a machine 244. The quiescence posture data containing both pitch data showing the volume data characteristic of the preliminary adjustment fly height volume of a flection 20 and the preliminary adjustment fly height pitch of a flection are given to a processor 502 by the machine 244 (step 516).

[0063] After quiescence posture measurement is completed, only in release, an air press actuator 454 pushes aside a processor 502 to the load beam clamp location where 472 showed the adjustment frame 450 below to drawing 13 C through [in a flange] the load beam clamp stroke for those actuator arms 466 (step 518). When the adjustment frame 450 moves through the clamp stroke, a hard field is pushed aside below from the fly height location currently held by the elevator pin 442 so that the load beam clamp pad 474 might engage with the hard field 26 of a suspension system 14 and a hard field might engage with the top face of the emission rod 334. With the continuous action of the adjustment frame 450, the clamp pad 474 clamps the hard field 26 of a suspension system 14 to the clamp side 322 of the base 252. If the hard field 26 of a suspension system 14 is clamped by the field 322, it will be pushed aside by the emission rod 334 in the location from which it withdrew in the base 252.

[0064] Following quiescence posture measurement, a processor 502 calculates the difference between the measured preliminary adjustment pitch and a nominal pitch, and determines desired pitch change (Dptich) (namely, amount of the

pitch adjustment which should be made by the station 206) (step 520). or [and / calculating the location which a processor 502 accesses suspension system adjustment data according to a desired pitch change, and is called a "bump"] -- or it determines. A bump is a flection bending location which produces a desired pitch change (step 522). The bump relates to change of the request of (Dheight), a volume (Droll), and a gram load (Dgram) by height functionally like Dptich so that it may mention later in a detail. So, the mathematical algorithm used by the processor 502 is Pitch, Dheight, and Droll. And Dgram A bump is calculated as a function. With the gestalt of the operation described here, a processor 502 calculates a bump about the number of the required steps which must drive a stepper motor 488 in order to make the bending assembly 490 go up and down from the migration location. And a stepper motor 488 drives the bending assembly 490, and it acts by the processor 502 so that the tip of a pin 496 may be positioned in a desired flection bending location (step 524). And a stepper motor 488 is made to act, the bending assembly 490 is driven so that it may return to a migration location, and it completes like a pitch adjustment fault (step 526). A flection 20 is bent by it in the location which is a request or gives a nominal pitch to a flection (after like the laser adjustment fault at a station 208 mentioned later), when a flection is raised by it to fly height.

[0065] Since the suspension system clamp assembly 240 is driven by retracting the clamp frame assembly 352 and the adjustment frame 450 so that it may return to the suspension system migration location, if the substrate clamp valve 508 and the load beam clamp valve 510 are made to act again by the processor 502, it will complete like quiescence posture measurement and a pitch adjustment fault (step 510). If the adjustment frame 450 is retracted from the clamp location, the spring assembly object 338 will press return and a plunger 332 upwards to the extended location, and the hard field 26 of a suspension system 14 will be raised from the clamp side 322 of the base 252. Similarly, if the clamp frame assembly 352 is drawn in from the substrate clamp location, the spring assembly object 310 will push aside a rod 308 upwards, the suspension system substrate boss 23 will be flattered from a hole 306, and a suspension system 14 will be released from the clamp assembly 240. And the suspension system 14 which measured the quiescence posture and which reached and adjusted the pitch can be advanced from the clamp assembly 240. And it is repeatable like the above-mentioned quiescence posture measurement and a pitch adjustment fault to other suspension systems 14.

[0066] The laser aligner station 208 is described with reference to drawing 11 , and 28-31. Like illustration, the laser aligner station 208 has the substrate clamp assembly 540, the load current-beam-position arrangement assembly 542, the load beam clamp assembly 544, an optical fiber 546, z height measurement machine 548, and the gram load measurement assembly 550. The substrate clamp assembly 540 has the fixed base 552 and the migration clamp member 554. It is fixed about walking-beam 101", and the base 552 has the ********** substrate clamp pad 556 so that alignment of the substrate 21 of a suspension system 14 may be received and carried out. The plunger 558 energized by means of a spring is located at the core of the clamp pad 556. The migration clamp member 554 is driven so that it may have the clamp pad 560 and between a migration (disconnection) location and clamp locations (closing) may be reciprocated about the base 552 synchronizing with actuation of walking-beam 101". First like a laser adjustment fault, the clamp member 554 is in the migration location (not shown) in which spacing was kept from the base 552. And the suspension system 14 which should be adjusted is advanced to the clamp assembly 540 walking-beam 101". After the suspension system substrate 21 is adjusted by walking-beam 101" at the clamp pad 556 and a straight line, the clamp member 554 drives to the clamp location indicated to be drawing 28 to 30, and clamps a substrate functionally among the clamp pads 556 and 560. By that cause, the attachment field of a suspension system 14 is clamped, it leads like a laser adjustment fault, and fixed maintenance is carried out at the laser aligner station 208. A laser adjustment fault can drive the clamp member 554 to the migration location following completion of postadjustment z height and gram load measurement, and can release a suspension system 14, and a suspension system can be advanced from the laser aligner station 208 by walking-beam 101".

[0067] It can be the same as that of the above-mentioned machine 232, and about a gram load and the outline measurement station 204, it is positioned so that the height parameter of the suspension system 14 clamped by the clamp assembly 540 may be measured, and z height measurement machine 548 is **************. The gram load measurement assembly 550 has the load cell 562 which has the measurement probe 582. The drive assembly 564 has the arm assembly 566, the arm mounting 568, and an air press actuator 570. The arm mounting 568 is supported by the frame 572. It has the piston (it is not visible) connected with the rod 578 which the air press actuator 570 is attached in the frame 574 in the location above the arm mounting 568, and has been prolonged through arm mounting by the color 576. the edge of the arm assembly 566 located below the arm mounting 568 carries out the fixed coupling to a rod 578 -- having -- **** -- and the line of arm mounting -- it has the guidance shaft 580 prolonged up into bearing (it is not visible). A load cell 562 adjoins the clamp assembly 540, it is attached in the edge of the arm assembly 566, and the measurement probe 582 of the load cell above the flection 20 of the suspension system 14 clamped by the clamp assembly is positioned.

[0068] Between the location from which the air press actuator 570 acted with the control system 500, and the arm assembly 566 and the load cell 562 were withdrawn and the extended locations, i.e., a measuring point, is driven. In the retreating location, clearance sufficient for the suspension system 14 which a load cell 562 should be raised above the load current-beam-position arrangement assembly 542, and should pass laser aligner station 208 by walking-beam 101", and should move forward from a laser aligner station is given. In a measuring point, a load cell 562 drives below, and the measurement probe 582 is made to engage with the flection 20 of a suspension system 14, and a suspension system is lifted to fly height. Extent of downward movement of a load cell 562 is restricted by the stopper block 584 of the crowning of the arm mounting 568, and engagement of a color 576. The vertical position of the stopper block 584 about the arm mounting 568 and the fly height in which a suspension system 14 is lifted when a load cell 562 so drives to the extended location can be adjusted using a micrometer 586.

[0069] The load beam clamp assembly 544 has an air press actuator 590, an arm 592, and a bracket 594. It has the piston 598 which the air press actuator 590 is being fixed to the frame 596, and was attached in the end of an arm 592 with the color 600. The bracket 594 is attached in the edge of the arm 592 which counters a color 600. The optical fiber 546 and the load beam clamp pad assembly 602 are attached in the bracket 594. With the gestalt of implementation of illustration, the load beam clamp pad assembly 602 has three POGO pins 604 energized below toward the load current-beam-position arrangement assembly 542 with the spring 606. The optical fiber 546 is attached in the bracket 594 so that the edge of a fiber may be positioned above the leg of the spring field 24 of the suspension system 14 clamped by the station 208 in the edge of a fiber, as best shown in drawing 28 . The clamp pad assembly 602 is attached in the bracket 594 so that an assembly may be positioned above the hard field 26 of the suspension system 14 clamped by the station 208. An air press actuator 590 acts with a control system 500, and between the location from which the arm 592, the optical fiber 546, and the clamp pad assembly 602 were withdrawn and the extended locations, i.e., a load beam clamp location, is driven.

[0070] The load current-beam-position arrangement assembly 542 has the stepper motors 610A-610C and the gage pin assemblies 612A-612C which are driven by the motor. The gage pin assemblies 612A-612C have the gage pins 616A-616C which are attached in the edge of the arms 614A-614C connected with each motor 610A-610C, and an arm, and are prolonged upwards from the edge of an arm. It is ************** so that Pins 616A-616C may be positioned below the hard field 26 of the suspension system 14 with which Arms 614A-614C were clamped at the station 208 as best shown in drawing 29 and 31. With the gestalt of special implementation of illustration, mostly, along with the lateral load beam axis, it is located below a part for the core of the hard field 26, and Pins 616A and 616B have kept spacing symmetrically from the main longitudinal direction load beam axis. Below the back part of the hard field 26, pin 616C adjoins a field 24 in a flange, and is located at the main longitudinal direction axis. Stepper motors 610A-610C drive the gage pin assemblies 612A-612C for between the retreating location and the extended adjustment positions. When it is in the retreating location, gage pins 616A-616C are in the location which gives sufficient clearance for the suspension system 14 which should pass station 208 and should be advanced from a station.

[0071] The electric subsystem 509 of the laser aligner station 208 is mostly shown in drawing 32 . Like illustration, the electric subsystem 509 has stepper motors 610A-610C, a load cell 562, z height measurement machine 548, the load beam clamp valve 618, the load cell elevator valve 620, and semiconductor laser 622. The load beam clamp valve 618 connects the source of a compressed air (not shown) with an air press actuator 590 through a hose like 624 (drawing 11). Similarly, a valve 620 connects the source of a compressed air with an air press actuator 570 through a hose 624.

[0072] Like the laser adjustment fault performed by the station 208 z height, volume, and gram load of a suspension system 14, maintaining a load beam at a position and orientation By driving the hard field 26 from the free condition to a position and orientation, in order to ease stress by what a spring field is heated for, and in order to apply stress to the spring field 24 (for example, thing for which an infrared laser beam is applied), an advanced precision, It can adjust to repeatable nature and stability possible [prediction]. Before stress relaxation of the magnitude of z height which occurred according to this process or was caused, a volume, and gram gravity dependent opacity is carried out, it depends for it on the amount of stress and distribution which the spring field 24 receives, and this stress level and distribution can be controlled by the location and orientation of a load beam about that free condition location and orientation.

[0073] Therefore, the adjustment data showing the fly height gram load of the request according to a load beam adjustment position and orientation, height, and volume change are memorized by the memory 504 of a control system 500. A load beam adjustment position and orientation are the locations and orientation which the load beam 26 drives with the positioning assembly 542 from the free condition location. With the gestalt of the desirable operation indicated here, adjustment data are characterized by a series of linearity and nonlinear equality describing the gram load, the height, and volume change according to an adjustment position and orientation. A load beam adjustment position is a

flat location established with gage pins 616A-616C. If other ways are described, with the gestalt of implementation of a publication, locator pins 616A-616C will drive a laser adjustment fault here to the location which supports the load beam 26 of the inside suspension system 14 in a flat location and orientation. each which is driven from those retreating locations in order that the adjustment position of each pins 616A-616C may position a pin to a desired adjustment position -- it can be made to relate mutually to the number of step motors 610A-610C The fly height gram load for a suspension system 14, height, and the request of a volume or the data representing a nominal value is also memorized by memory 504.

[0074] Drawing 33 is a flow diagram which shows the suspension system 14 clamped by the clamp assembly 540 like the laser adjustment fault performed by the station 208. When the clamp member 554 is in the migration location, the process starts with migration of height, a gram load, and the suspension system 14 that should be rolled and adjusted, closes a clamp member, and clamps the attachment field 18 functionally at the base 552 among the clamp pads 560 and 556 (step 630). The difference (namely, desired change) between the values (respectively Dgram, Dheight, Droll, and Pitch) of the measured preliminary adjustment and the gram load of nominal rating of a request, height, a volume, and a pitch is calculated by the processor 502 (step 632). or [and / that a processor 502 calculates the adjustment height of Pins 616A-616C by accessing adjustment data according to change of a request of a gram load, height, a volume, and a pitch] -- or it determines (step 634). And stepper motors 610A-610C act by the processor 502 so that the gage pin assemblies 612A-612C may be driven upwards and Pins 616A-616C may be positioned to an adjustment position (step 636).

[0075] After the gage pin assemblies 612A-612C drive to those adjustment positions, a processor 502 makes the load beam clamp valve 618 act so that the pneumatic pressure arm 590 may drive to the load beam clamp location which indicated the arm 592 and the load beam clamp pad assembly 602 of the edge to be drawing 28 to 30 from the retreating location (step 638). The POGO pin 604 of the clamp pad assembly 602 is positioned immediately on gage pins 616A-616C. If the clamp pad assembly 602 is dropped from the retreating location, a suspension system will be pushed aside to the adjustment position to which the POGO pin 604 engages with the top face of the hard field 26 of a suspension system 14, and the inferior surface of tongue of a hard field is engaging with the tip of gage pins 616A-616C. If the energization force in which a spring 606 is big enough is applied to the POGO pin 604, a POGO pin will push aside the hard field 26 of a suspension system 14 so that it may engage with gage pins 616A-616C. After a POGO pin pushes aside the load beam 16 to an adjustment position, with downward movement which the clamp pad assembly 602 follows, a POGO pin resists the energization force of a spring 606, and it withdraws into a bracket 594. Where the load beam 26 is held at an aligner station, a processor 502 makes the laser 622 between the exposure times act, and if the spring field 24 passes an optical fiber 546, stress relaxation will be heat-treated and carried out by applying the infrared radiation turned to the field (step 640). Laser 622 turns OFF by the processor 502 in the end of the exposure time, it can be made to be able to cool and a suspension system can be placed (step 642 (the gestalt of 1 operation about 30 msec)). In order to complete like this laser adjustment fault, a processor 502 makes the load beam clamp valve 618 and stepper motors 610A-610C act, drives the clamp pad assembly 602 and the gage pin assemblies 612A-612C, and returns to those retreating locations (step 644).

[0076] A postadjustment gram load and z height (outline shape property) measured value are taken at the station 208 which continues like a laser adjustment fault. The elevator valve 620 acts by the processor 502 like a laser adjustment fault, and it drives caudad to the measuring point to which the suspension system 14 has raised the load cell 562 to fly height. And a processor 502 takes postadjustment fly height gram load measured value from a load cell 562 (step 646). If a suspension system is lifted to fly height, a processor 502 will make z height measurement machine act, and postadjustment radial field outline measured value will be taken (step 648). Following these postadjustment measurement, a processor 502 makes the elevator valve 620 act, drives a load cell, and returns to the retreating location (step 650). And the clamp member 554 can be driven to the migration location (it opened wide), and the suspension system [finishing / measurement] 14 can be advanced from the clamp assembly 540 by walking-beam 101' by the adjustment (step 652).

[0077] The quiescence posture measurement station 210 can be described in relation to drawing 11 , and 34 and 35. Like illustration, a station 210 has the suspension system clamp assembly 660 and the quiescence posture measurement machine 662. The quiescence posture measurement machine 662 can be the same as the machine 244 mentioned above in relation to the station 206 in structure, a function, and an operation. Except for the difference described immediately, the suspension system clamp assembly 660 is identified in the reference figure to which the same description attached the common subscript (namely, "x'") identically in the suspension system clamp assembly 240 mentioned above in relation to the station 206, structure, the function, and the operation. The difference between the clamp assemblies 660 and 240 is based on flection pitch measurement not being performed at a quiescence posture measurement station. So, a

load beam or adjustment clamp actuation is not performed by the clamp assembly 660, adjustment frame 450' is not used, and it is fixed to frame plate 362of clamp frame assembly 352' ' with a bolt 664. Unlike the suspension system clamp assembly 240 of a station 206, the suspension system clamp assembly 660 does not have an air press actuator like 454 for driving frame plate 450' to a load beam clamp location, or an energization spring like 472.

[0078] Drawing 36 is the block flow diagram of the electric subsystem 511 of the quiescence posture measurement station 210. Like illustration, although the electric subsystem 511 has the quiescence posture measurement machine 662 and the functional clamp valve 666, these both have interfaced with the processor 502.

[0079] Drawing 37 is a flow diagram which shows the quiescence posture measurement process performed by the station 260. The process starts while a clamp assembly is in a suspension system migration location (not shown), and transporting the suspension system 14 which should be measured to the suspension system clamp assembly 660 (step 668). Air press actuator 354' retracts the actuator arm 360', and it is made for a processor 502 to have the clamp assembly 660 in a suspension system migration location by making the load beam clamp valve 666 act so that it may drive up to the location from which load beam clamp assembly 248' was withdrawn. After advancing the suspension system 14 which should be measured to the clamp assembly 660, a processor 502 makes the load beam clamp valve 666 act so that it may drive to the substrate clamp location which pneumatic pressure arm 354' extended the actuator arm 360', and showed load beam clamp frame assembly 352' to drawing 35 (step 670). When clamp frame assembly 352' is in the clamp location, elevator pin 442' engages with the hard field 26 of the load beam 16, and the load beam 16 is raised from the free condition to fly height.

[0080] After the substrate 21 of a suspension system 14 is functionally clamped by base 252' and the flection 20 is raised by fly height, a processor 502 makes the quiescence posture measurement machine 662 act. A machine 662 generates a light beam and it is made to point to it through hole 480' to up to a flection 20, as shown in drawing 35 . The postadjustment quiescence posture data which contain both pitch data showing the volume data characteristic of the postadjustment fly height volume of a flection 20 and the postadjustment fly height pitch of a flection by that cause are given to a processor 502 by the machine 662 (step 672). The load beam clamp valve 666 acts by the processor 502 again, and if it drives so that the suspension system clamp assembly 660 may be returned to the suspension system migration location by retracting clamp frame assembly 352', postadjustment quiescence posture measurement will be completed (step 668). And the quiescence posture measurement process which the suspension system 14 with which the quiescence posture was measured could be advanced from the clamp assembly 660, and was mentioned above is repeated with the following suspension system.

[0081] the design specification of a request of the postadjustment gram load, height, and quiescence posture of a suspension system 14 -- if out of range, a suspension system will refuse -- having -- a design -- it is cut from a carrier strip at a dee tab station out of specification. And the carrier strip 34 which has the suspension system 14 within the design specification which remains is removed from a machine 200, and is conveyed to a purification station (not shown). Following purification actuation, a suspension system 14 is conveyed to the last dee tab station, and all the remaining suspension systems 14 are cut from the carrier strip 34 there, and it is succeedingly packed to a customer for transportation. In the gestalt of other operations, a suspension system 14 is heat-treated following those adjustments with equipment 200.

[0082] In order to control like a pitch adjustment fault by the station 206 and to control like a gram load, height, and a volume adjustment fault (namely, laser alignment procedure) by the station 208, the algorithm detailed publication carried out by the processor 502 is as follows. The mathematical equality (Eqs.) which it is contained in an algorithm and mentioned later is shown in drawing 38 . Change of the pitch made at stations 206 and 208 as mentioned above, a gram load, height, and a volume Pitch, Dgram, Dheight, and Droll It has expressed, respectively. These parameters are calculated by the processor 502 according to equality 1-4. The gestalt of the algorithm operation described here uses four response variables (response variables) expressed with a "load", "bias", the "pivot", and a "bump." These response variables are defined as equality 5-9 about the relative pin location of the pitch adjustment device 242 of a station 26, and the load current-beam-position arrangement assembly 542 of a station 208, in order to make the amount of connection or dependence into min.

[0083] Equality 9-12 is used in order to calculate the pivot, bias, a load, and a bump, respectively. As indicated by drawing 38 , in addition to change of a request of a pitch, a gram load, height, and a volume, equality 9-12 uses weight factor "A"- "N" like the count constant "a constant" indicated by equality 13-19, "alpha", "p", "q", "Det", "u", and "v." The numerical system indicated by equality 1-19 was formatted so that there might merely be only an actual root of a lot and two pairs of united virtual ****. This numerical system can also remove the need for what kind of kind of convergence count technique, and can be undone using direct combo lute transformation (convolute transform).

[0084] It was observed that there is a detailed difference by the method of answering like the pitch adjustment fault to

which the various classes of suspension system 14 or a design was performed at the station 206. In order to explain these differences, the characteristic of the formula 12, such as having been used in order to calculate a bump, contains strange good "power." This strange good power is attached and set as each format of the suspension system 14 in a setting process performed by the processor 502. For example, it was set up when adjusting the suspension system 14 of the available format 1650 from HATCHINSON Technology, Incorporated, and the power was equal to 13.

[0085] Among a setting process, in order that a processor 502 may establish weight factor A-N, a TICHU routine is carried out. A processor 502 performs a perfect factorial by the load in a setting process, bias, and the pivot. A bump is changed regardless of a load, bias, and the pivot among this setting process. Among this setting process, in order to memorize the preliminary adjustment by which a gram load, height, the pitch, and the volume were measured, a postadjustment value, and the related adjustment position and to calculate the initial value of weight factor A-N, it is processed by Gaussian recursion. By the example, it is the HATCHINSON Technology, Incorporated format 850. The typical numeric value of weight factor A-N for a suspension system is indicated to the lower table 1. In addition based on the adjustment position (namely, data relevant to mutual) which was updated based on the difference between weight factor A-N, therefore the gram load of a request of a count constant of a suspension system 14, height, a pitch and a volume and the postadjustment value by which a gram load, height, the pitch, and the volume were measured, and was related, it is updated. With the gestalt of 1 operation, weight factor A-N is continuously updated following adjustment of each suspension system 14 and postadjustment measurement using historical mutual associated data from the predetermined number of the suspension systems 14 processed most recently (for example, the gestalt of 1 operation 80).

[0086]

[Table 1]

$A = 9.59655 \times 10^2$

$B = 4.224$

$C = -33.378$

$D = 18.357$

$E = -5.73643 \times 10^2$

$F = -94.246$

$G = -56.948$

$H = -0.6379$

$I = 11.59$

$J = -0.05835$

$K = 0.1114$

$L = 0.57972$

$M = -3.457$

$N = 5.304$

[0087] On the whole, the suspension system adjusting device 700 which is the gestalt of other operations of this invention is shown in drawing 39 . Like illustration, equipment 700 has the volume module 702 and the adjustment module 704. The volume module 702 had the pitch stabilization station 706, the volume station 708, reverse bending, and the gram load measurement station 710, and these all have interfaced with the control system 712. The adjustment module 704 had a gram load and the height measurement station 714, the quiescence posture measurement station 715, the pitch aligner station 716, the laser aligner station 717, the quiescence posture measurement station 718, the gram load, and the height measurement station 719, and these all have interfaced with the control system 726.

[0088] A walking beam (not shown in drawing 39) like the walking beam mentioned above about the suspension system adjusting device 100 rolls the carrier strip 34 of the shaping suspension system 14 (not shown [this]), makes it move forward through a module 702, and positions each suspension system 14 to stations 706, 708, and 710 succeedingly. After being positioned at each stations 706, 708, and 710, it is processed before moving forward to the station which the substrate 21 of a suspension system 14 is functionally clamped in the attachment field 18, and a clamp is canceled, and continues. All actuation of the volume module 702 and all actuation of the stations 706, 708, and 710 are unified, and it is controlled by the control system 712.

[0089] At the pitch stabilization station 706, the flection 20 of a suspension system 14 is heated and residual stress is eased. With the gestalt (each component of that is not shown) of 1 operation, this stress relaxation heating actuation is performed by exposing a flection 20 to the infrared radiation which was generated with semiconductor laser and turned to the flection with one or more optical fibers. Although sufficient stress relaxation heat for a flection 20 is applied, in

order to apply the heat which does not act as Browning, a control system 712 can be set up by the method of the station -106 of the above-mentioned adjusting device 100, and the same method. It can heat, in order that the hard field 26 of a suspension system 14 may also ease residual stress by the method of a flection 20, and the same method.

[0090] At the volume station 708, the spring field 24 of a suspension system 14 is wound around the surroundings of the curved mandril, and a spring field is formed. The volume station 708 can be the same as the volume station 102 of the above-mentioned adjusting device 100 structurally and functionally.

[0091] At reverse bending and the gram load measurement station 710, a suspension system 14 helps to carry out reverse bending only of the predetermined amount of setup, and to decrease the gram load of a suspension system, and to stabilize a gram load by that cause. the device and structure target which are used in order that the reverse bending device (not shown separately) in a station 710 may perform reverse bending actuation at the reverse bending station 202 of the above-mentioned adjusting device 200 -- and it can be functionally the same. A station 710 has a gram load measurement machine (not separately shown in drawing 40) for measuring the postvolume gram load of a suspension system 14. The postvolume gram load measured value made at the station 710 can be rolled, and it can use among the setting process of a station 708. The gram load measurement machine in a station 708 can be the same as the gram load measurement machine of a station 714 structurally and functionally, and is later mentioned by the detail.

[0092] The adjustment module 704 has a walking beam (not shown) for positioning each suspension system succeedingly at stations 714-719, in order to advance the carrier strip 34 (not shown) of a suspension system 14 through a module. After being positioned at each stations 714-719, a suspension system 14 is functionally clamped in the attachment field 18, and it is processed before advancing a clamp to the station which cancels and continues. All actuation of the adjustment module 704 and all actuation of the stations 714-719 are generalized, and are controlled by the control system 726.

[0093] A suspension system 14 is lifted by fly height at a gram load and the height measurement station 714. And the preliminary adjustment height (namely, parameter of an outline configuration) and preliminary adjustment gram load of a suspension system 14 are measured, using respectively a load cell and z height measurement machine (not shown in drawing 39).

[0094] At the quiescence posture measurement station 715, a suspension system is again lifted by fly height. And the preliminary adjustment quiescence posture (both a volume and a pitch) of a flection 20 is measured using a quiescence posture measurement machine (not shown in drawing 39).

[0095] In the pitch aligner station 716, the fixed clamp of the hard field 26 of a suspension system 14 is carried out. And a flection 20 is bent the upper part or caudad plastically according to a pitch adjustment device (not shown in drawing 39), and the pitch of a flection is adjusted. A pitch adjustment device can be the same as the pitch adjustment device 242 of the aforementioned adjustment machine 200 structurally and functionally.

[0096] In the laser aligner station 717, by the adjustment position, a load current-beam-position arrangement assembly (not shown in drawing 39) carries out orientation of the hard field 26 of a suspension system 14, and positions it, and applies stress to the spring field 24. And stress relaxation is carried out by applying the infrared radiation with which the spring field 24 occurred with laser, and was turned to the spring field through the optical fiber. Thereby, the gram load, height, and volume of a suspension system 14 are adjusted. A load current-beam-position arrangement assembly can be the same as the load current-beam-position arrangement assembly 542 of the above-mentioned adjusting device 200 structurally and functionally. Laser and an optical fiber can be the same as that of the fiber 546 of an adjusting device 200, and laser 622. The algorithm used by the control system 726 in order that the pitch adjustment fault performed at a station 716 may control like a gram load, height, and a volume adjustment fault by the station 717, and in order to update adjustment data can be the same as the algorithm enforced by the processor 502 of the adjusting device 200 mentioned above.

[0097] At the quiescence posture measurement station 718, a suspension system 14 is lifted again to fly height. And the postadjustment quiescence posture of a flection 20 is measured using a quiescence posture measurement machine (not shown in drawing 39). The quiescence posture measurement station 718 can be the same as a station 715 structurally and functionally. A suspension system 14 is lifted by fly height at a gram load and the height measurement station 719. And the postadjustment height of a suspension system 14 and a postadjustment gram load are measured using a load cell and z height measurement machine (not shown in drawing 39), respectively. A gram load and the height measurement station 724 can be the same as a station 714 functionally and structurally.

[0098] Although not shown in drawing 39 , the adjustment module 704 has a refusal suspension system dee tab station, and moves forward to this station by the back walking beam by which the suspension system 14 was measured at the station 719. A refusal suspension system dee tab station interfaces with a control system 726, and it is controlled by the control system 726. The design suspension system 14 (namely, predetermined [of a desired quiescence posture, height

and a gram load] suspension system which has the measured postadjustment quiescence posture out of range, height, or a gram load) out of specification is cut from the carrier strip 34 at this station. The dee tab station of this format is common knowledge, for example, is U.S. Pat. No. 4,603,567 of Smith and others. It is indicated. And the carrier strip 34 which has the suspension system 14 within a design specification is removed with a help from a walking beam at a gram load and the height measurement station 719, and is conveyed to the last dee tab station. All the remaining suspension systems 14 are cut from the carrier strip 34 at the last dee tab station, and it is packed in order to convey to a customer succeedingly.

[0099] A gram load and the height measurement station 714 are stated to a detail with reference to drawing 40 . Like illustration, a station 714 has a suspension system clamp / arm assembly 728, the gram load measurement assembly 730, and z height measurement machine 732. The gram load measurement assembly 730 is attached in the support frame 736 on the base 734, and has a stepper motor 738, the slide mounting 740, the support arm 742, and a load cell 744. The slide mounting 740 is attached possible [reciprocation] along with a perpendicular axis about the support frame 736, and is driven through the movement range with a stepper motor 738. The support arm 742 was attached in the slide mounting 740, and it has extended from slide mounting. It is located immediately on the flection 20 of the suspension system 14 which the load cell 744 was attached in the edge of the support arm 742, has been prolonged from the edge to the lower part, and was clamped by the clamp / actuator assembly 728. A control signal is answered from a control system 726 (drawing 39), and a load cell 744 is driven for between the location or migration location from which the stepper motor 738 withdrew, and fly height measurement stations. In a migration location, it is raised so highly enough that it does not interfere with the suspension system 14 with which a load cell 744 passes a suspension system clamp / actuator assembly 728, and is moving forward from this assembly. If it descends to a measuring point, a load cell 744 will engage with a flection 20, will lift a suspension system 14 to fly height, and will enable fly height gram load measurement by the load cell. In order to adjust the measuring point of a load cell 744, the adjustment device 746 can be used.

[0100] z height measurement machine 732 is attached in the base 734 in Shimo's location from the hard field 26 of the suspension system 14 clamped with the clamp / actuator assembly 728. It is positioned so that the height parameter of a suspension system 14 may be measured, after a suspension system is lifted with the gram load measurement assembly 730 to fly height, and a machine 732 is **************. An optical point range sensor like the machine 232 mentioned above about the adjusting device 200 can be used for this purpose. At the gestalt of 1 operation, a machine 732 is available LC 2430 from KEYENCE CORP. of Japan and Osaka. It is a point range sensor.

[0101] With reference to drawing 40 -43, a suspension system clamp / actuator assembly 728 is described. Like illustration, the assembly 728 is attached above the walking-beam feed shaft 729, and has the base assembly 750, the locator-pin block assembly 752, the functional clamping block assembly 754, the load beam actuator block assembly 756, and the cam assembly 758. The base assembly 750 has the hard attachment base 760 with the substrate clamp field which has the base plate clamp pad 762. The dimension arrangement is carried out so that the attachment boss 23 of the suspension system 14 which the alignment hole 766 is prolonged into the clamp pad 762, and was clamped by the clamp pad may be accepted. The rise-and-fall rod 764 is attached possible [reciprocation] in a hole 766, and it is energized upwards with the spring 768. The guide bar 770 was fixed to the base assembly 750, and it has extended from the base 760 to the upper part and a lower part.

[0102] The cam assembly 758 has the castellated shaft 776 attached pivotable in the base assembly 750. the positioning cam 778 -- it wears clamp cam 780, and a shaft 776 is equipped with the actuator cam 782 by the spline, and it rotates with the shaft.

[0103] the locator-pin block assembly 752 -- under from the base assembly 750 -- being located -- **** -- and a line -- it has the guidance block 772 attached possible [a reciprocating motion perpendicular to the guide bar 770] by bearing 774. The top face of the guidance block 770 has a crevice 784, and the inside of this crevice is attached in the cam follower 786 by the guidance block pivotable. The cam follower 786 is located possible [engagement] by the positioning cam 778 of the cam assembly 758. the near tension spring (not shown) with which the guidance block 772 counters connects between the guidance block 772 and the base assembly 750 -- having -- **** -- the locator-pin block assembly 752 -- the upper part -- and the cam follower 786 is energized so that it may engage with the positioning cam 778.

[0104] The locator-pin assembly 788 containing the support arm 790 and a pin 792 (there is even free [no] in drawing 40 , and 41 and 43 deer vanity) is attached before the guidance block 772. The pin 792 is prolonged upwards through the hole 35 of the suspension system carrier strip 34, and the hole of the adjusted base 760, when the substrate 21 of a suspension system is located above the clamp pad 762. The support arm 790 and a pin 792 drive between the location which answered rotation of a shaft 776 and was extended, and the retreating locations through a carrier strip positioning

stroke. The positioning cam 778 and a cam follower 786 collaborate so that the location of a pin 792 may be controlled within those positioning strokes.

[0105] the functional clamping block assembly 754 -- the base assembly 750 immediately top -- being located -- **** -- and a guide bar 770 top -- a line -- it has the guidance block 794 attached possible [a perpendicular reciprocating motion] by bearing 796. The inferior surface of tongue of the guidance block 794 has a crevice 798, and the cam follower 800 is attached pivotable in this crevice at the guidance block. The cam follower 800 is located possible [engagement] by the clamp cam 780 of the cam assembly 758. the near tension spring 802 with which the guidance block 794 counters connects between the guidance block 794 and the base assembly 750 -- having -- **** -- the clamping block assembly 754 -- a lower part -- and the cam follower 800 is energized so that it may engage with the clamp cam 780.

[0106] The substrate clamp assembly 804 which has the support arm 806 and the clamp pad assembly 808 is attached before the guidance block 794. The clamp pad clamp assembly 808 is attached in the location immediately on the clamp pad 762 on the base 760 in ** 810 of the support arm 806. As best shown in drawing 43 , the clamp pad clamp assembly 808 has a spring 812, the jewel ring 814, and the clamp pad 816. The clamp pad assembly 808 is the same as the clamp pad assembly 370 of the aforementioned adjusting device 200 structurally and functionally. The clamp pad assembly 808 answers rotation of a shaft 776, and drives between a migration location and substrate clamp locations through a clamp stroke. The clamp cam 780 and a cam follower 800 collaborate so that the location of the clamp pad assembly 808 may be controlled within the clamp stroke.

[0107] the clamping block assembly 754 immediately top with the functional load beam arm block assembly 756 -- being located -- **** -- and a line -- it has the guidance block 820 attached possible [a perpendicular reciprocating motion] in the guide bar 770 top by bearing 822. The inferior surface of tongue of the guidance block 820 has a crevice 824, and the cam follower 826 is attached pivotable in this crevice at the guidance block. The cam follower 826 is located possible [engagement] by the actuator cam 782 of the cam assembly 758. the near tension spring 828 with which the guidance block 820 counters connects between the guidance block 820 and the base assembly 750 -- having -- **** -- the actuator block assembly 756 -- a lower part -- and the cam follower 826 is energized so that it may engage with the actuator cam 782.

[0108] The load beam operation member or assembly like the elevator assembly 830 is attached before the guidance block 820. The elevator assembly 830 positions the elevator pin 834 above the hard field 26 of the suspension system 14 which it had the support arm 832, and this support arm is prolonged from the guidance block 820, and was clamped between the clamp pad 762 and the clamp pad assembly 808. The elevator assembly 830 drives between the location from which rotation of a shaft 776 was answered and it withdrew, and the locations which rose through an elevator stroke. The actuator cam 782 and a cam follower 826 collaborate so that the location of the elevator assembly 830 may be controlled within the elevator stroke.

[0109] As roughly shown in drawing 40 , a suspension system clamp / actuator assembly 728 has the control system 840 which interfaces the walking-beam feed shaft 729 with the cam assembly 758. The control system 840 is shown in the detail at drawing 44 , and it has an optical encoder 842, the motor controller 844, and a motor 846. An optical encoder 842 generates the electric position signal with which it connects with the walking-beam feed shaft 729 optically by the method of common use, and the location of a feed shaft is expressed. The motor controller 844 is a programmable motor controller of ********** common use, as the position signal from an encoder 842 is received. The motor controller 844 has interfaced with the control system 726 of the adjustment module 704 like illustration. A control system 726 gives control command to the motor controller 844, and receives information from a motor controller. Thereby, a control system 726 can synchronize with actuation of a suspension system clamp / actuator assembly 728 actuation (namely, actuation of the gram load measurement assembly 730 in a station 714, and z height measurement machine 732) of the function which a control system controls.

[0110] The motor controller 844 is programmed to generate a motorised signal according to the control command received from the position signal and control system 726 which received from the encoder 842. The motorised signal produced by the controller 844 is added to a motor 846 by the method of common use (for example, not shown through Motor Driver). Rotation of a cam shaft 776 therefore the carrier strip guidance actuation performed with the locator-pin block assembly 752, the substrate clamp actuation performed with the functional clamping block assembly 754, and the load beam rise actuation performed with the load beam actuator block assembly 756 synchronize with rotation of a feed shaft 729. The load beam rise actuation performed with the relative motion of the carrier strip guidance actuation performed with the positioning block assembly 752, the substrate clamp actuation performed with timing and the functional clamping block assembly 754, and the load beam actuator block assembly 756 synchronizes by the positioning cam 778, the clamp cam 780, and the actuator cam 782. Since the rate at which a suspension system 14

moves forward through the stations 714-719 of the adjustment module 704 relates to the rate which the walking-beam feed shaft 729 rotates directly, the actuation controlled by the control system 840 of a station 714, the control systems 726 of the adjustment module 704, and these control systems synchronizes effective in the rate at which the suspension system 14 is moving forward through an adjustment module.

[0111] A gram load and the height measurement station 714 act as follows. While the walking beam is advancing the suspension system 14 to the suspension system clamp / actuator assembly 728, a shaft 776 rotates with a control system 840 to the location where cams 778, 780, and 782 drive the locator-pin block assembly 752, the clamping block assembly 754, and the load beam actuator block assembly 756 to those extended locations, respectively. After the attachment field 18 of a suspension system 14 is positioned above the clamp pad 762, a pin 792 drives toward the extended location with continuation rotation of a shaft 776 through a carrier strip positioning stroke by the positioning cam 778. To coincidence, the clamp pad assembly 808 drives toward a clamp location by the clamp cam 780 through the clamp stroke. Before movement of a gage pin 792 draws movement of the clamp pad assembly 808, therefore a pin is prolonged through the hole 35 of the carrier strip 34 and the clamp pad assembly 808 engages with the attachment field 18 of a suspension system by that cause, a carrier strip is positioned after the substrate 21 of a suspension system 14 has been adjusted by the clamp pad 762 and the straight line. After a suspension system 14 is positioned and the clamp pad assembly 808 engages with the attachment field 18, a pin 792 and a clamp pad assembly drive to those extended locations by the positioning cam 778 and the clamp cam 780, and it is held in the extended location. The fixed clamp of the attachment field 18 and substrate 21 of a suspension system 14 is carried out at the base 760 between the clamp pad 762 and the clamp pad assembly 808.

[0112] Although the elevator assembly 830 drives to an elevator location through the elevator stroke by the actuator cam 782 while the clamp pad assembly 808 is driving toward the clamp location, movement of an elevator assembly is late for movement of a clamp pad assembly. After a suspension system 14 is clamped, when an elevator pin drives to the rise location, the elevator pin 834 engages with the load beam 16, and a load beam is raised to the location slightly beyond fly height. While the elevator pin 834 is driving to the rise location, the motor controller 844 gives directions to the control system 726 of the adjustment module 704. The directions are answered, a control system 726 generates a control signal, and, thereby, a stepper motor 738 drives a load cell 744 to the fly height measuring point. Once a load cell 744 is in a fly height measuring point, the elevator pin 834 will drive only a short distance toward the retreating location by the actuator cam 782, and the flection 20 of a suspension system 14 will be calmly positioned to up to a load cell. And the measured value of the fly height gram load of a suspension system 14 is taken. Moreover, while z height measurement machine 732 starts measurement of z height of a suspension system 14 with a control system 726, a suspension system is lifted by the load cell 744 to fly height. If a shaft 776 rotates further following a fly height gram load and z height measurement, the above-mentioned operation of the positioning block assembly 752, the clamping block assembly 754, and the load beam actuator block assembly 756 will be effectively repeated by the reverse order, in order to return the positioning cam 792, the clamp pad assembly 808, and a load cell 744 to those retreating locations. And the measured suspension system 14 can be advanced to the quiescence posture measurement station 715, and other suspension systems can be advanced to a gram load and the height measurement station 714.

[0113] The same suspension system clamp / actuator assembly as what was stated to just the front, and the related control system (that is, it is the same as that of an assembly 728 and a system 840) can be included in other stations of the volume module 702 and the adjustment module 704. The gestalt of one operation of a regulating system 700 has the suspension system clamp / same actuator assembly, and same control system as a station 710 and each 728 and 840 in 714-719. In order to use them for other stations of a regulating system 700, it can be made to suit effectively, if the modular property of a suspension system clamp / actuator assembly 728, and a control system 840 is given. For example, a suspension system clamp / actuator assembly 728 can be fitted in order to use for other stations by attaching various cams like 778, 780, and 782 in a shaft 776 in order to fit the changing timing requirement. It is also programmable in order to fit a control system 840 to the requirement of other stations.

[0114] It can also be made to suit in order to use the load beam actuator block assembly 756 of a suspension system clamp / actuator assembly 728 for other stations of an adjusting device 700. For example, the gestalt of operation of the suspension system clamp / actuator assembly of the pitch aligner station 716 instead of the elevator assembly 830 has the clamp pad 474 of the station 206 of an adjusting device 200, and the load beam actuator block assembly which has the same load beam clamp pad functionally. The base assembly of the suspension system clamp / actuator assembly of the pitch aligner station 716 has the same adjustment clamp field, a plunger, and a spring assembly object functionally with the clamp field 260 of the station 206 of an adjusting device 200, a plunger 332, and the spring assembly object 338. Thereby, a load beam actuator block and the base of the suspension system clamp / actuator assembly of a station 716 are ************** so that the pitch adjustment fault performed by the station may carry out the fixed clamp of

the hard field 26 of the inside suspension system 14.

[0115] The gestalt of operation of the suspension system clamp / actuator assembly of the laser aligner station 717 instead of the elevator assembly 839 has the clamp pad assembly 602 of the laser aligner station 208 of an adjusting device 200, and the load beam actuator block assembly which has the same clamp pad assembly structurally and functionally. Thereby, the load beam actuator block of the suspension system clamp / actuator assembly of a station 714 is ************** so that it may collaborate with the load current-beam-position arrangement assembly of a station 720. With the gestalt of this operation of the laser aligner station 717, the optical fiber is being fixed to the base in the location immediately under the spring field 24 of the suspension system 14 clamped at the station.

[0116] On the whole, the suspension system adjusting device 900 which is the gestalt of other operations of this invention is shown in drawing 45 . Like illustration, equipment 900 had the quiescence posture measurement station 901, the pitch aligner station 902, the laser aligner station 903, the quiescence posture measurement station 904, the gram load, and the height measurement station 905, and these all have interfaced in order to control a station 906. A walking beam (not shown in drawing 45) like the walking beam mentioned above about the suspension system adjusting device 100 advances the carrier strip 34 (not shown [this]) of the fabricated suspension system 14 through equipment 900, and positions each suspension system 14 to stations 901-905 succeedingly. After being positioned at each stations 901-905, before moving forward to the station which a clamp is canceled and continues, it is processed by clamping a suspension system 14 functionally in the attachment field 18. All actuation of stations 901-905 is unified by the control system 906, and is controlled.

[0117] At the quiescence posture measurement station 901, the preliminary adjustment quiescence posture (both a pitch and a volume) of a flection 20 is measured using a quiescence posture measurement machine (not shown in drawing 45). Although the quiescence posture measurement station 901 can be the same as the station 715 of the suspension system adjusting device 700 mentioned above structurally and functionally, a suspension system is not lifted by fly height for measurement.

[0118] In the pitch aligner station 902, the fixed clamp of the hard field 26 of a suspension system 14 is carried out. and the flection 20 -- a pitch adjustment device (not shown in drawing 45) -- the upper part -- or it is bent plastically caudad and the pitch of a flection is adjusted. A pitch aligner station can be the same as that of the station 716 of the suspension system adjusting device 700 mentioned above structurally and functionally.

[0119] In the laser aligner station 903, by the aligner station, a load current-beam-position arrangement assembly (not shown in drawing 45) carries out orientation of the hard field 26 of a suspension system 14, and positions it, and applies stress to the spring field 24. And stress relaxation of the spring field 24 is carried out by applying the infrared radiation which was generated with laser and turned to the spring field through the optical fiber. since a suspension system was not rolled, and it was not processed at a volume station like 708 of an adjusting device 700 namely,, a gram load and height are given to a suspension system 14 by the laser aligner station 903. The laser aligner station 903 actually includes the radius to the spring field 24. The volume of a suspension system 14 is adjusted at a station 903. In order to carry out like a laser adjustment fault, except for an algorithm change used and mentioned later, the laser aligner station 903 can be the same as that of the station 717 of the above-mentioned suspension system adjusting device 700 structurally and functionally.

[0120] At the quiescence posture measurement station 904, a suspension system 14 is lifted to fly height. And the postadjustment quiescence posture (both a volume and a pitch) of a flection 20 is measured using a quiescence posture measurement machine (not shown in drawing 45). The quiescence posture measurement station 904 can be the same as a station 901 structurally and functionally.

[0121] At a gram load and the height measurement station 905, a suspension system 14 is again lifted by fly height. And the postadjustment gram load and postadjustment height (namely, outline shape property) of a suspension system 14 are measured using a load cell and z height measurement machine, respectively (not shown in drawing 45). A gram load and the height measurement station 905 can be the same as the station 719 of an adjusting device 700 structurally and functionally.

[0122] The control system 906 of a regulating system 900 can have the control system 500 of an adjusting device 200, structure, and the same operation. Therefore, the algorithm enforced by the control system 906 is the same as the algorithm enforced by the control system 500. Since the main differences between the algorithms enforced by the control system 900 process the suspension system 14 around which stations 902 and 903 are not wound unlike a control system 500, they are not using a preliminary adjustment gram load or preliminary adjustment height. So, the preliminary adjustment gram load and preliminary adjustment height which are used by the algorithm and which were measured are zero effectively.

[0123] The suspension system adjusting device of this invention gives an important advantage. Especially, a suspension

system property like a gram load, a control system, and an outline configuration can be effectively established by an advanced precision and repeatable nature, and/or it can adjust to an advanced precision and repeatable nature. The property of the suspension system processed by this invention also demonstrates advanced stability.
[0124] It will be admitted that a configuration and details can be changed without describing this invention about the gestalt of desirable operation, however deviating from the pneuma and the range of this invention if it is this contractor. Especially, each suspension system and height gimbal assembly can be adjusted using systems 100,200,700 and 900.

[Translation done.]

* NOTICES *

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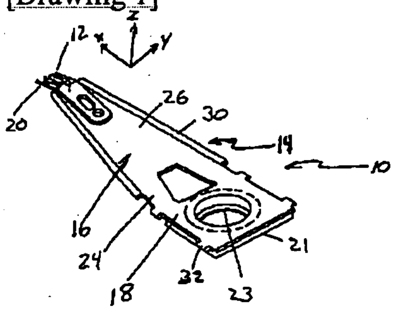
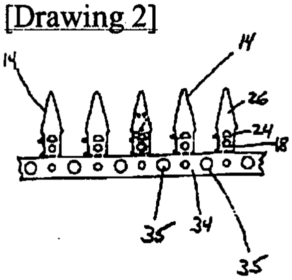
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

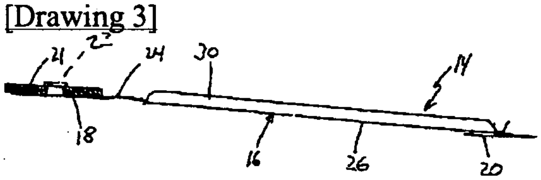
[Drawing 1]



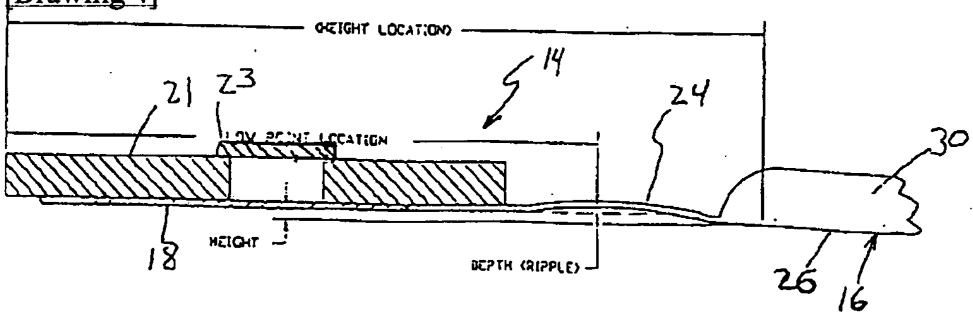
[Drawing 2]



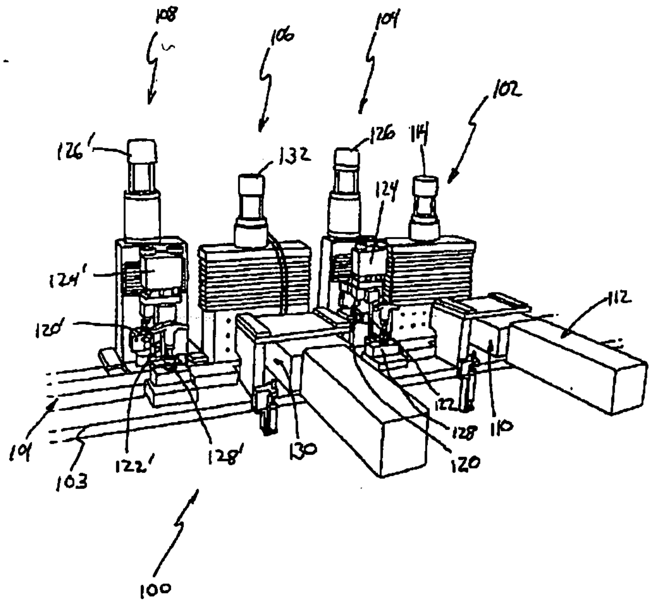
[Drawing 3]



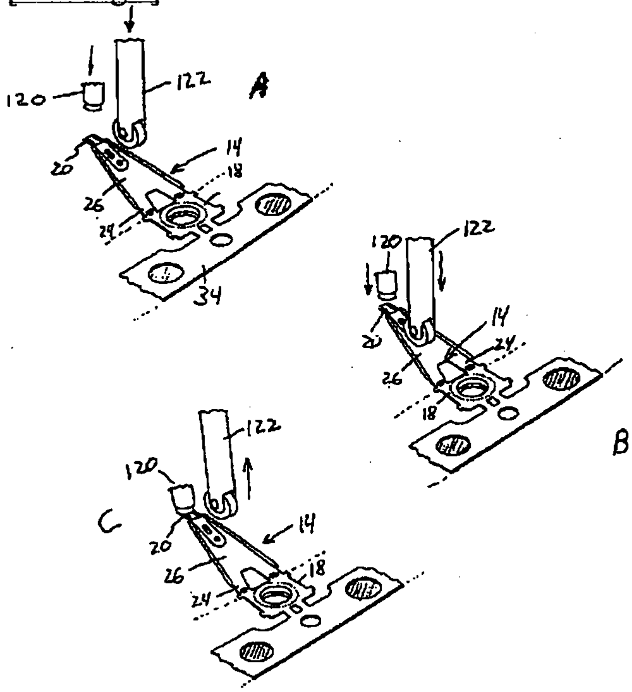
[Drawing 4]



[Drawing 5]



[Drawing 6]



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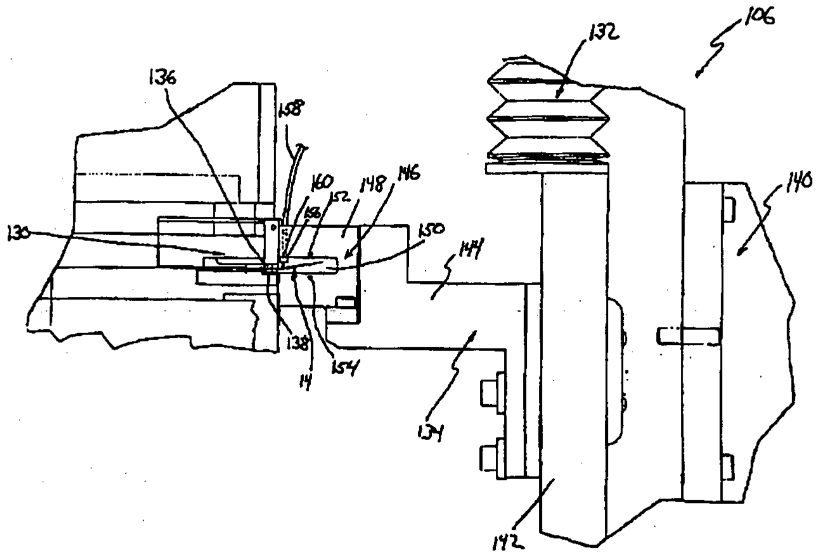
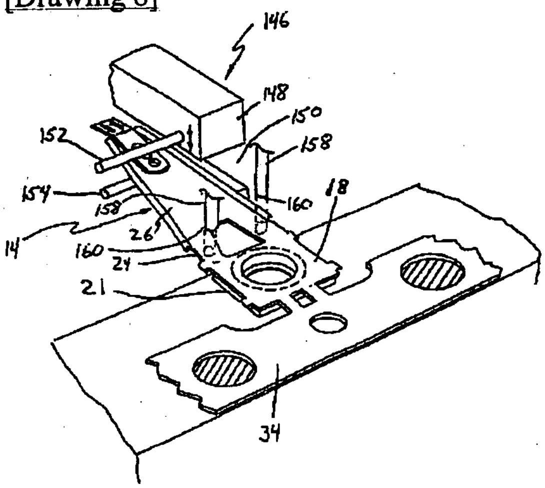
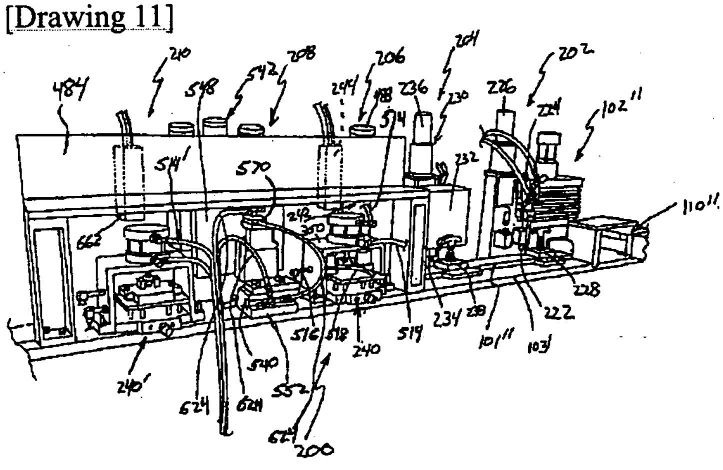


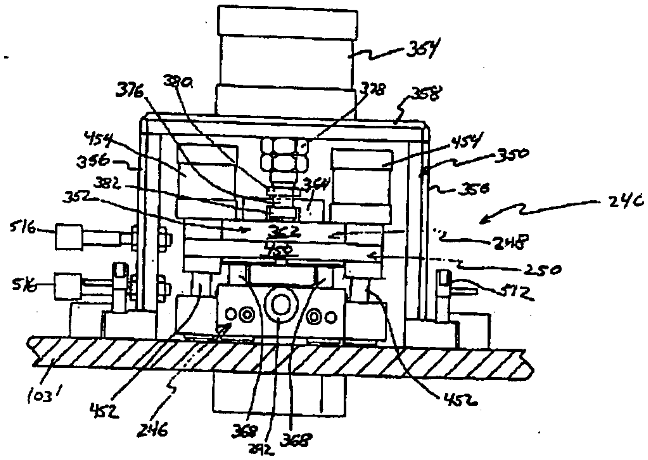
[Drawing 8]



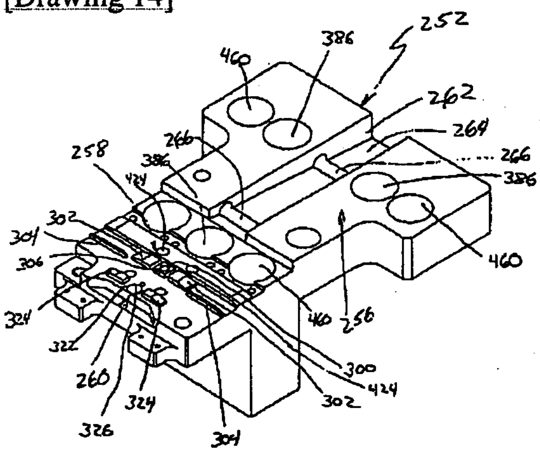
[Drawing 11]



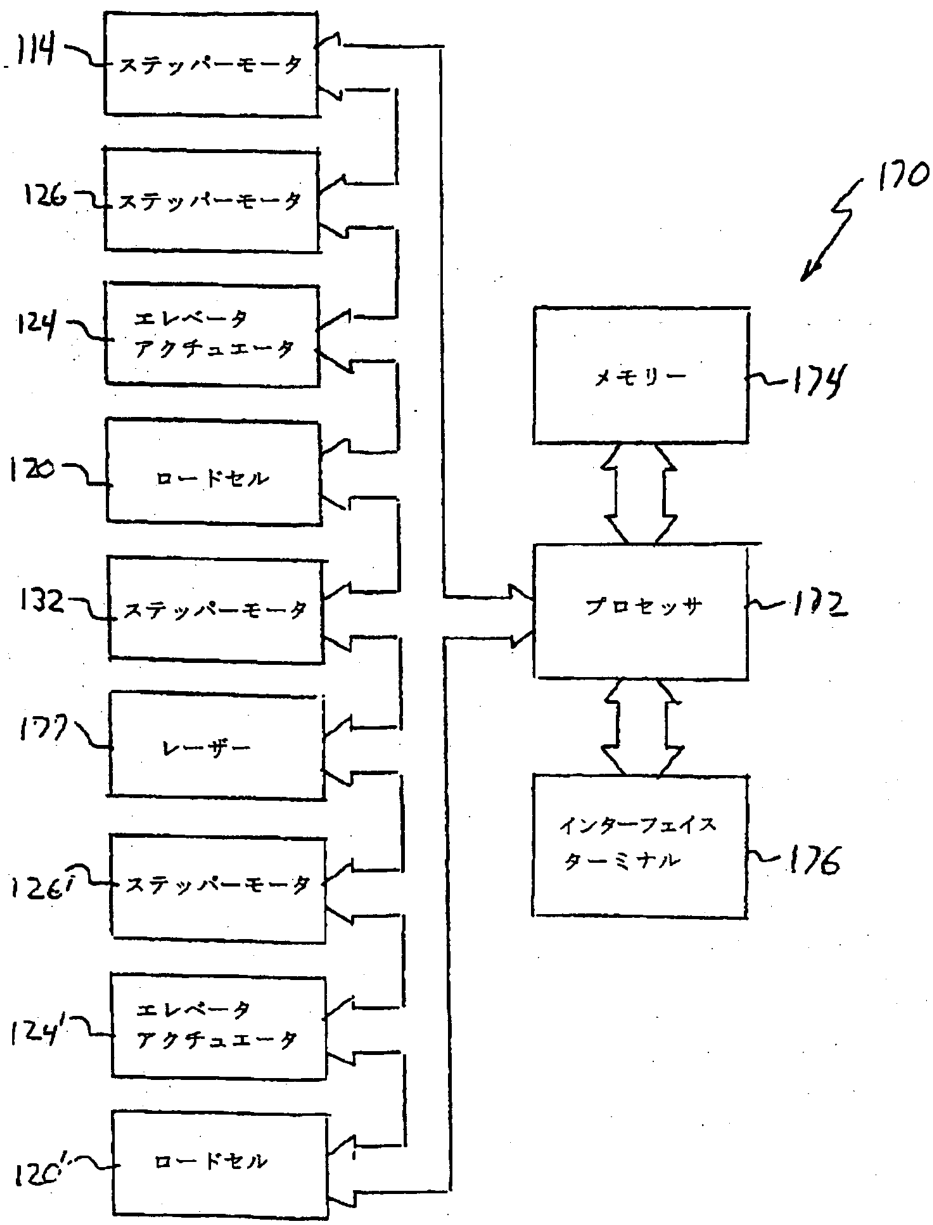
[Drawing 12]



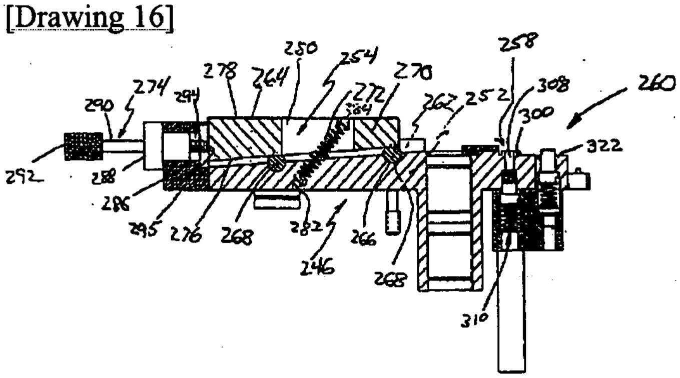
[Drawing 14]



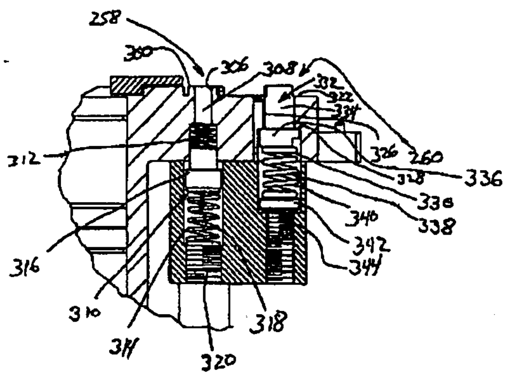
[Drawing 9]



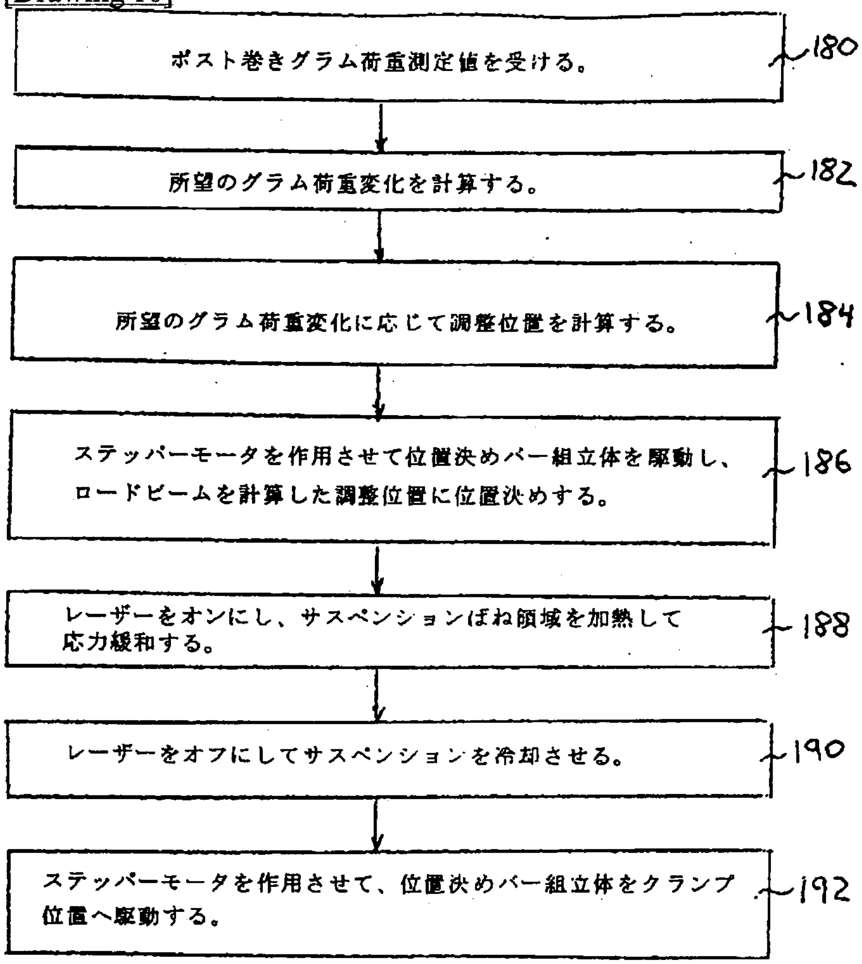
[Drawing 16]



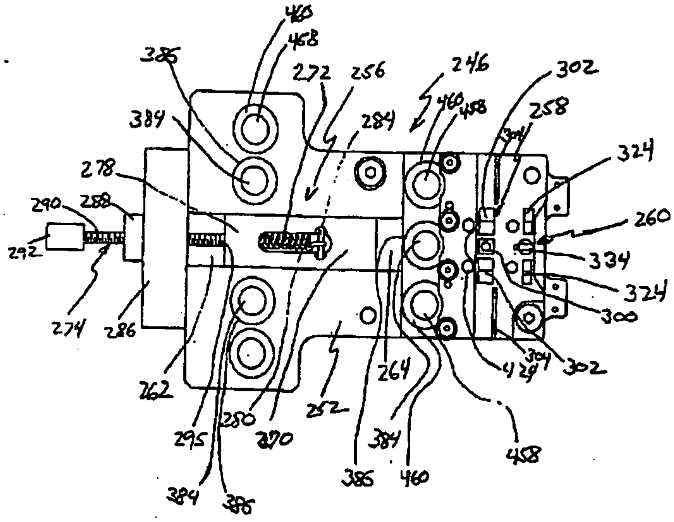
[Drawing 17]



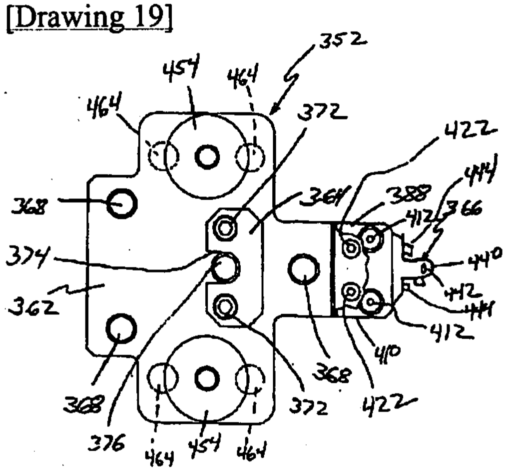
[Drawing 10]



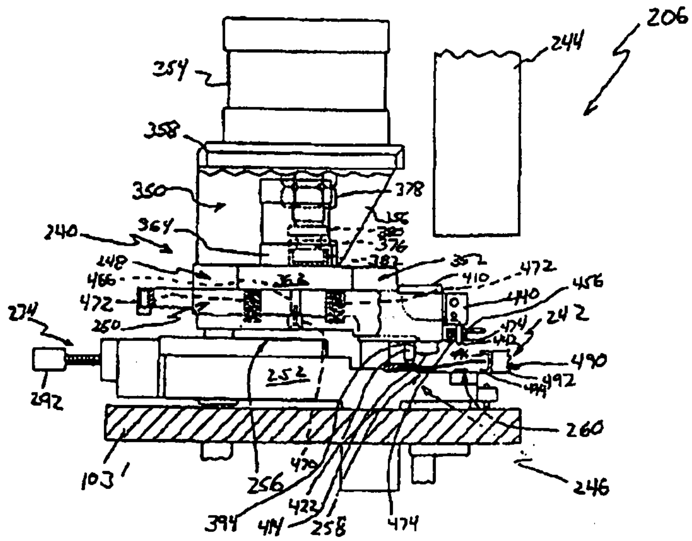
[Drawing 15]



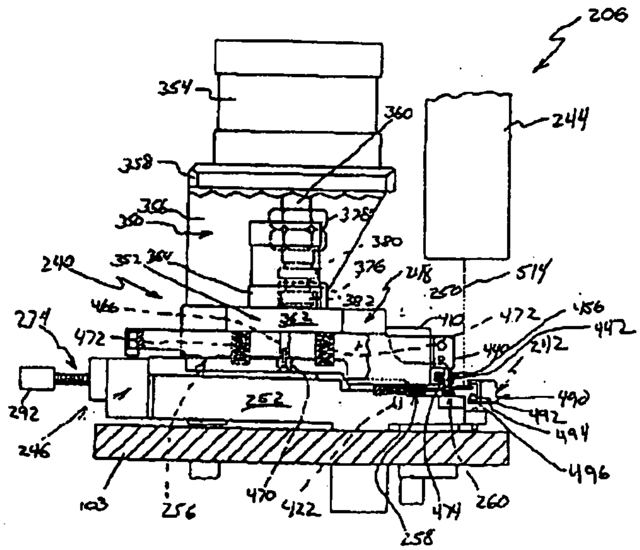
[Drawing 19]



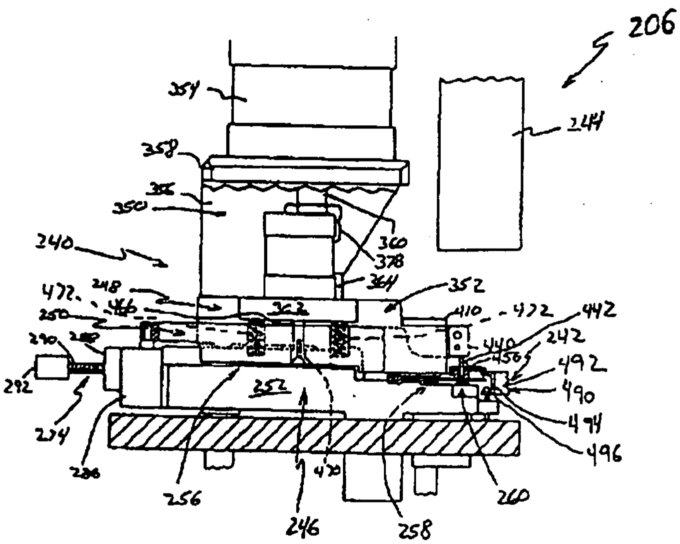
[Drawing 13]



A

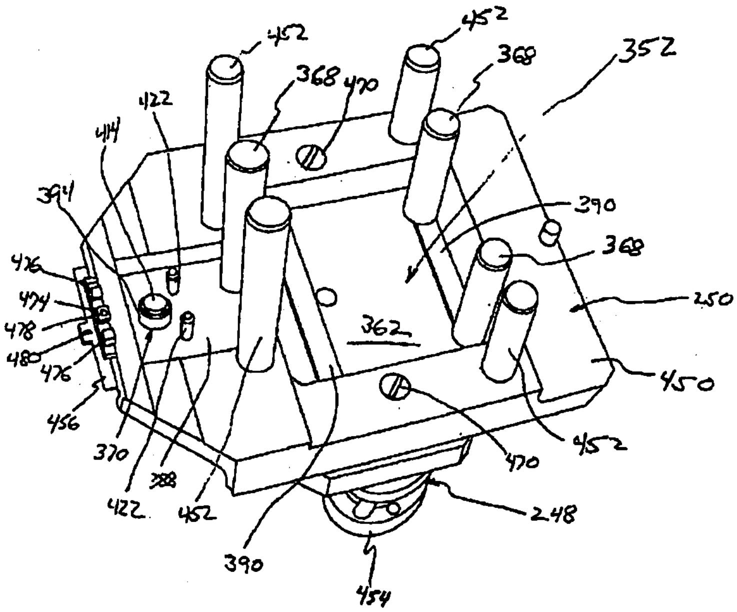


B

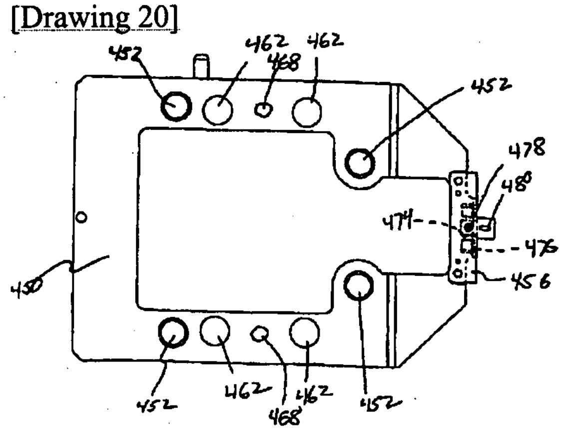


C

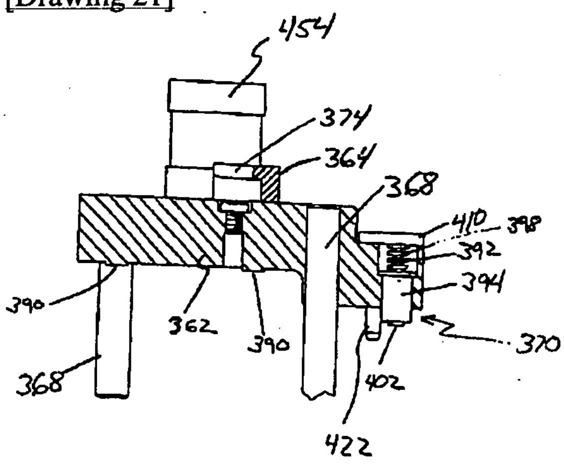
[Drawing 18]



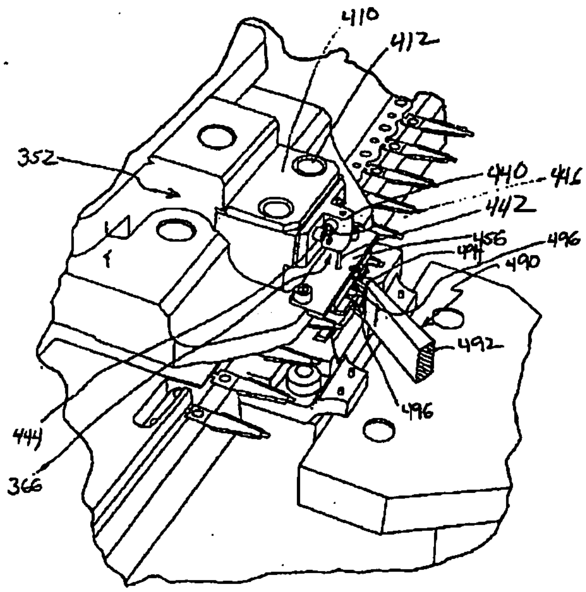
[Drawing 20]



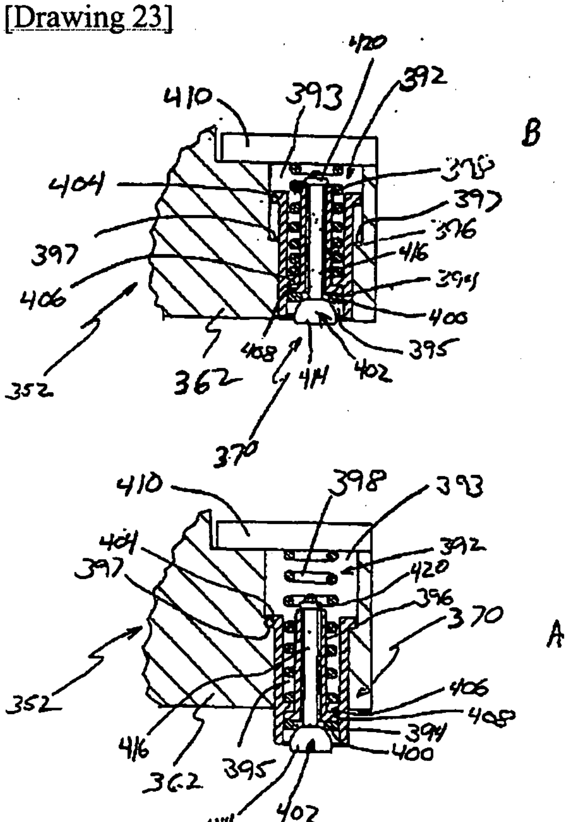
[Drawing 21]



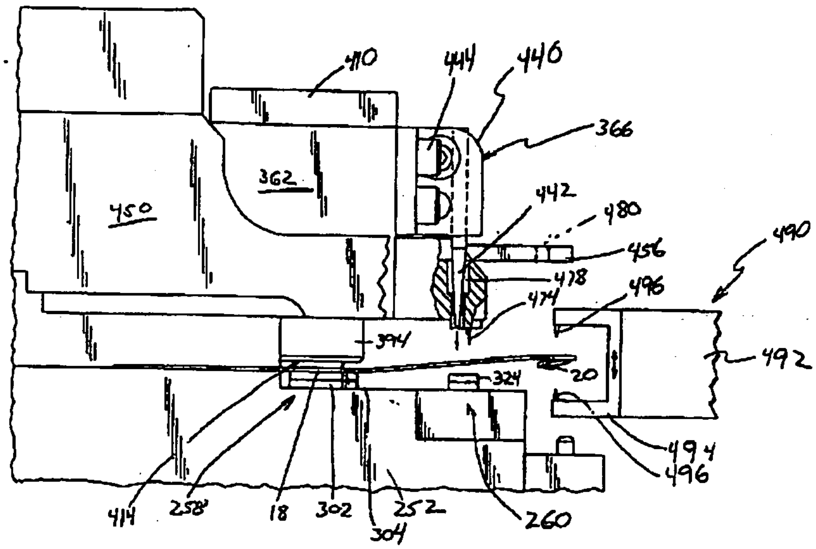
[Drawing 22]



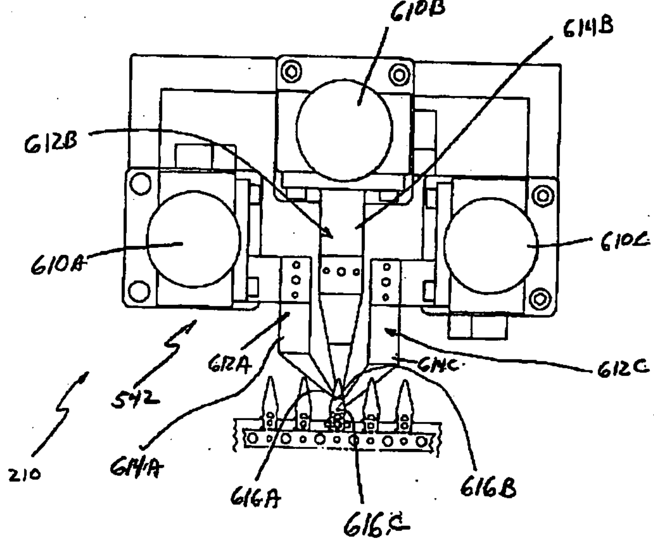
[Drawing 23]



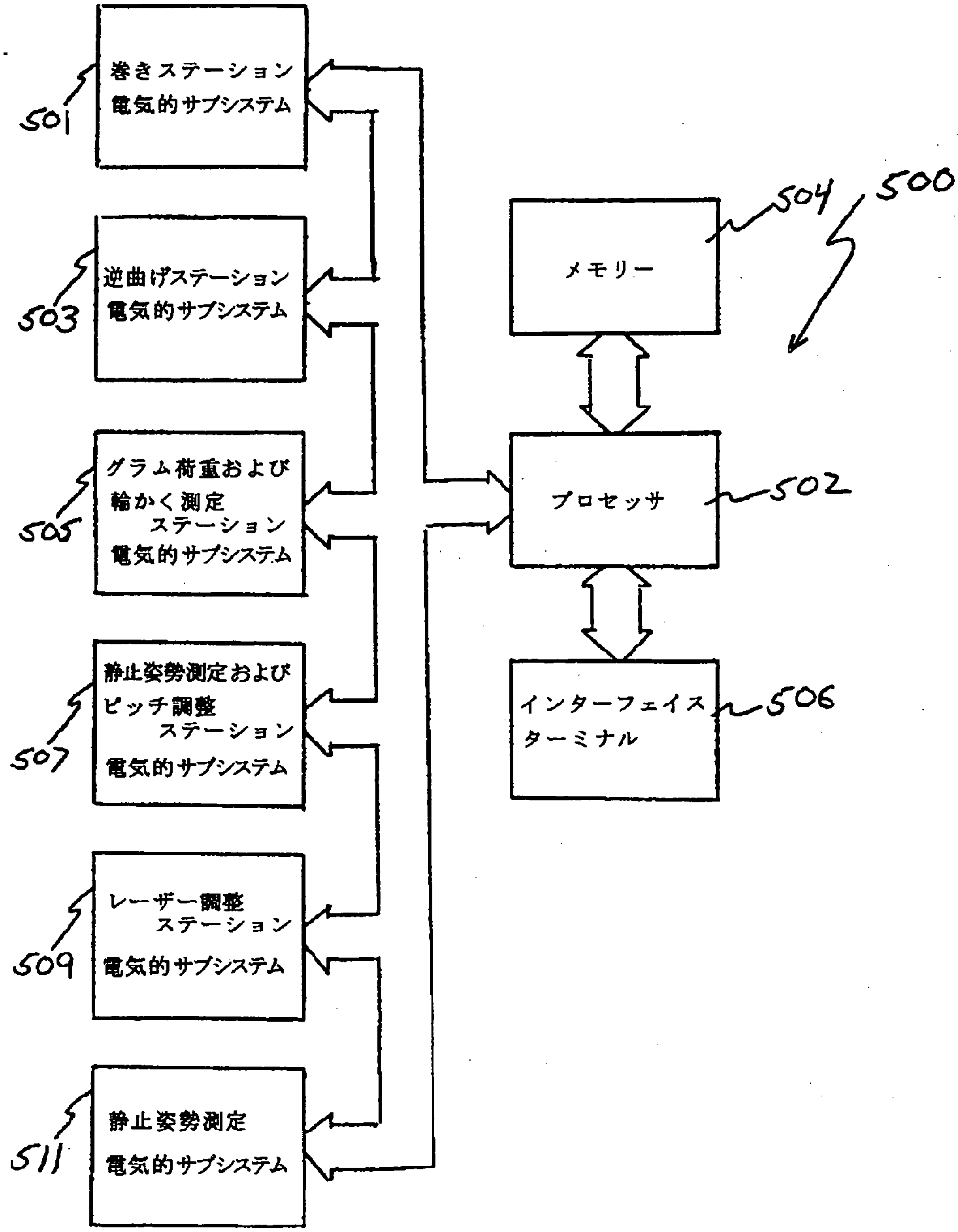
[Drawing 24]



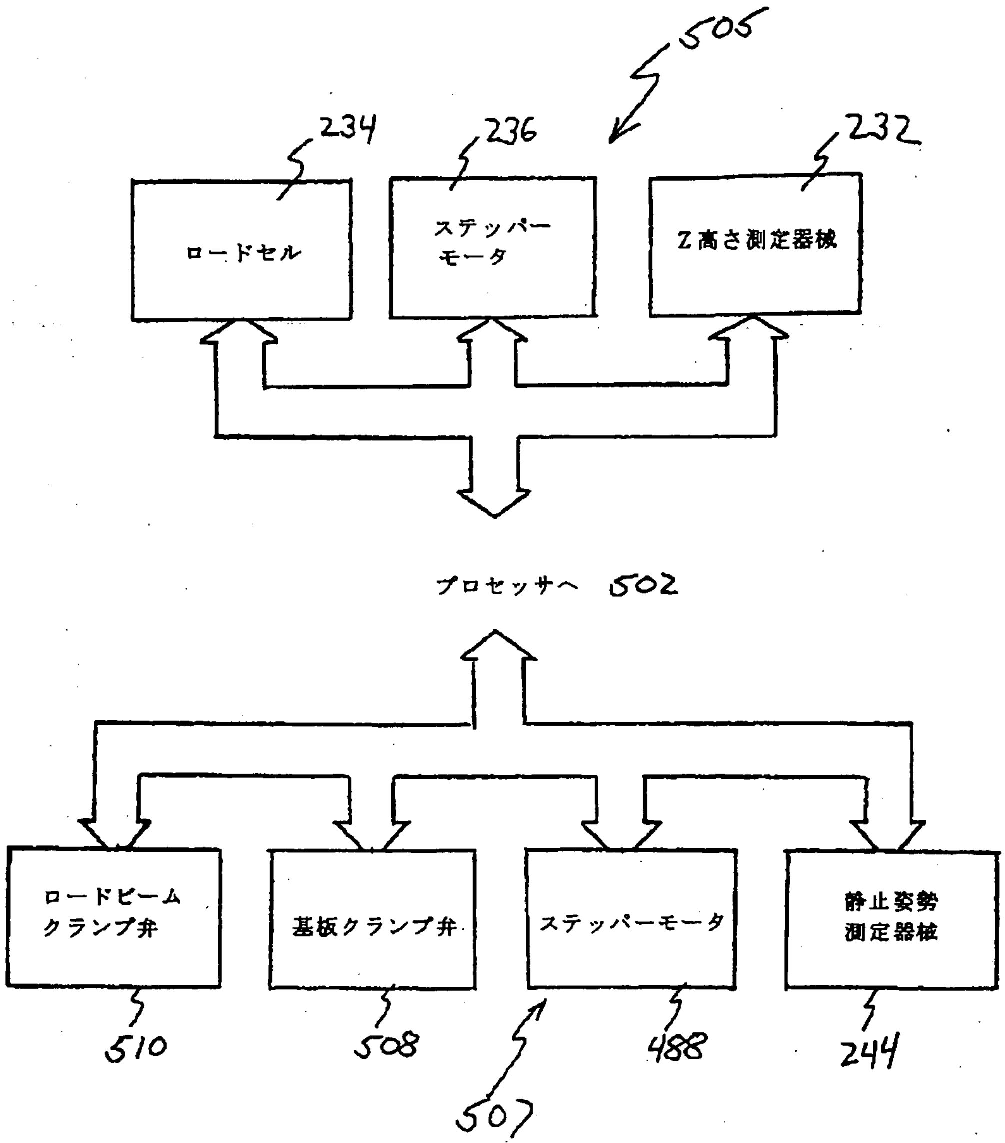
[Drawing 29]



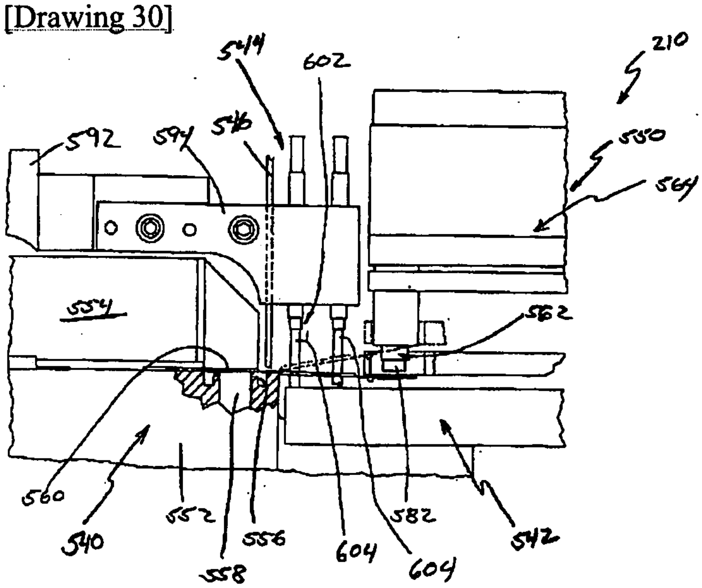
[Drawing 25]


巻きステーション
電気的サブシステム
501
逆曲げステーション
電気的サブシステム
503
グラム荷重および
輪かく測定
ステーション
電気的サブシステム
505
静止姿勢測定および
ピッチ調整
ステーション
電気的サブシステム
507
レーザー調整
ステーション
電気的サブシステム
509
静止姿勢測定
電気的サブシステム
511
メモリー
504
500
プロセッサ
502
インターフェイス
ターミナル
506

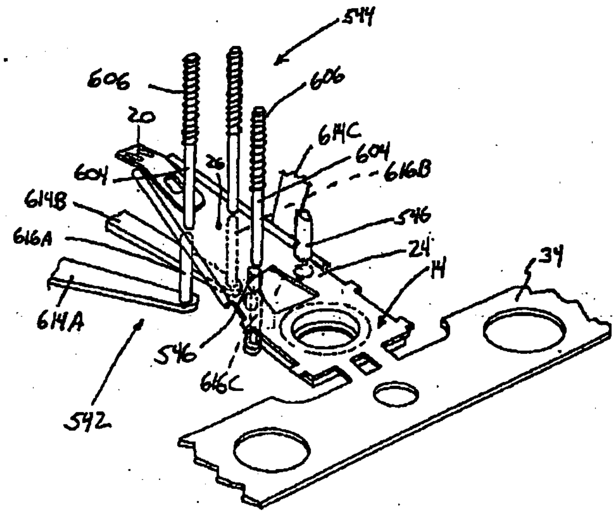
[Drawing 26]



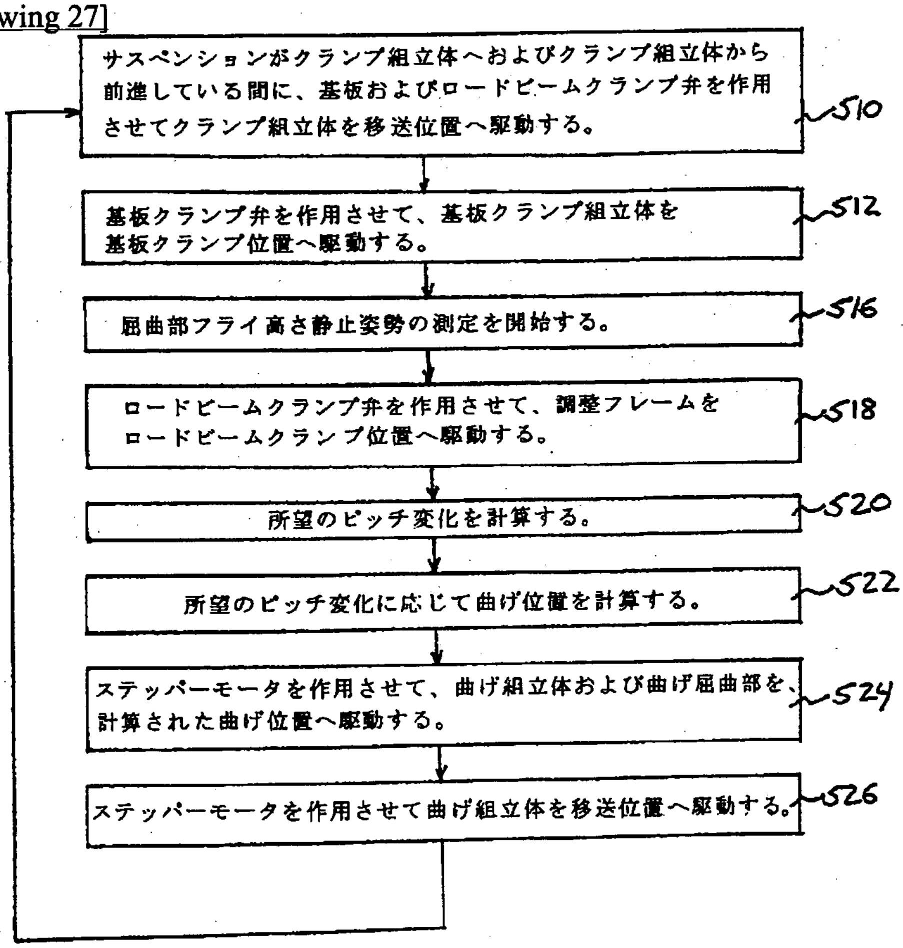
[Drawing 30]



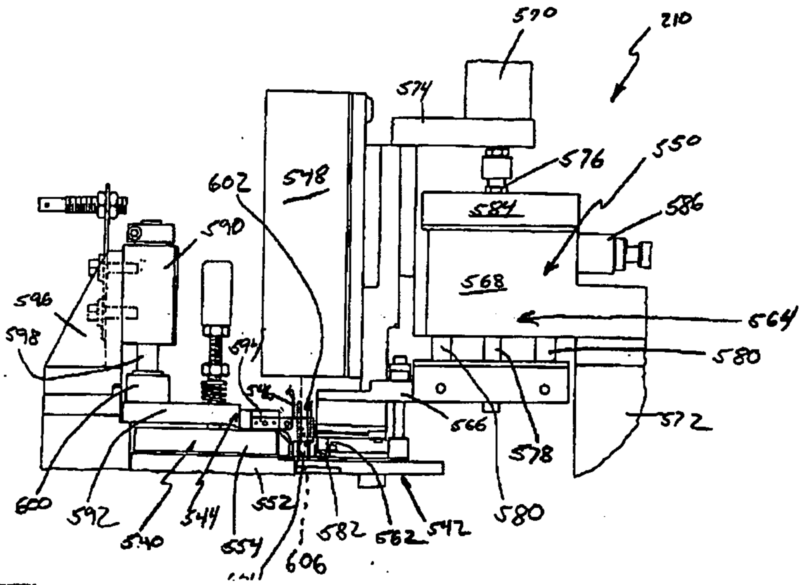
[Drawing 31]



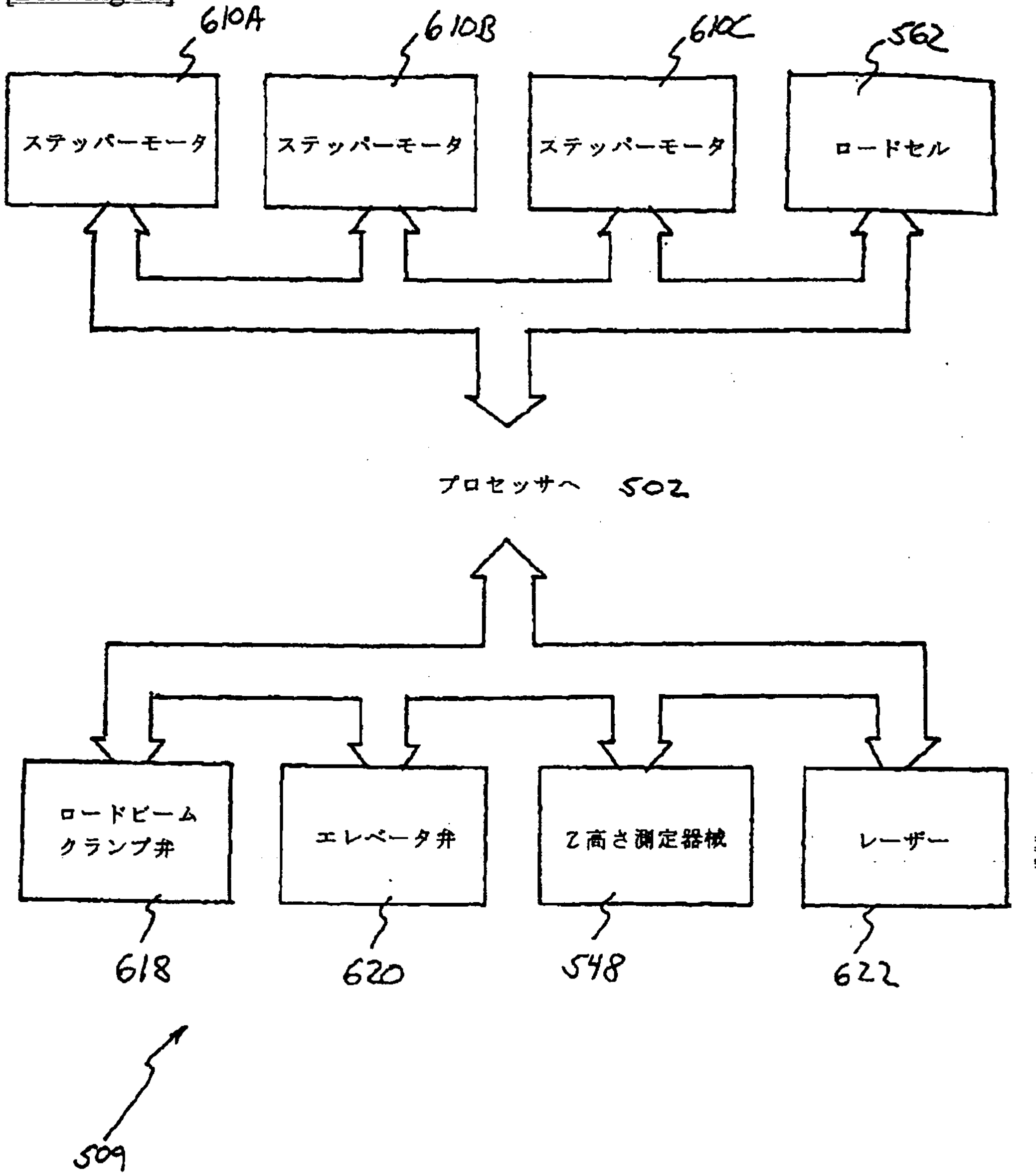
[Drawing 27]



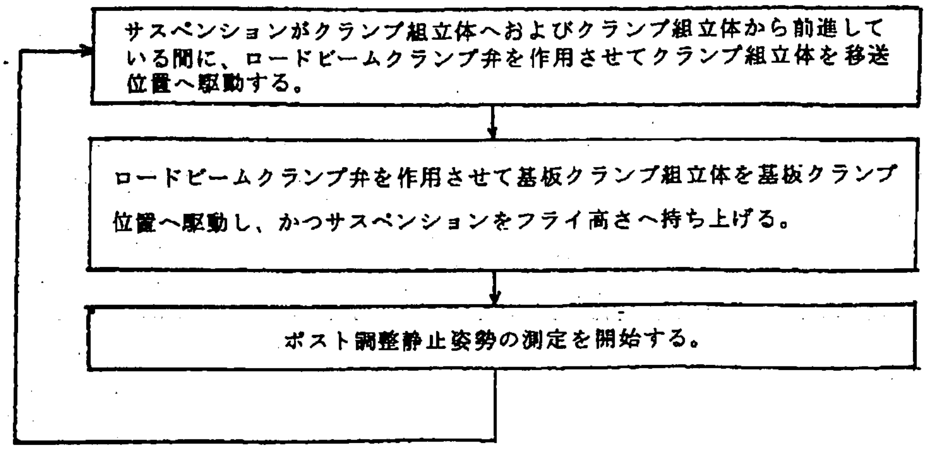
[Drawing 28]



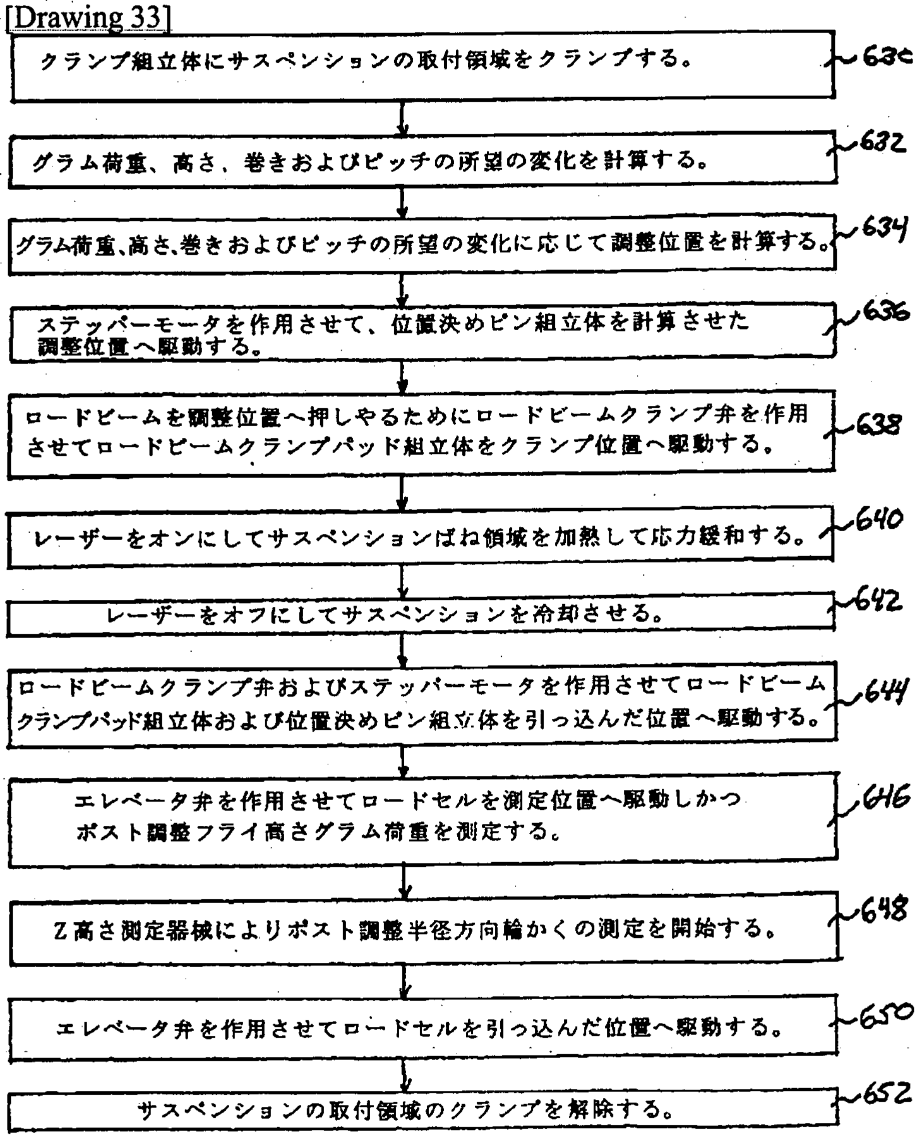
[Drawing 32]



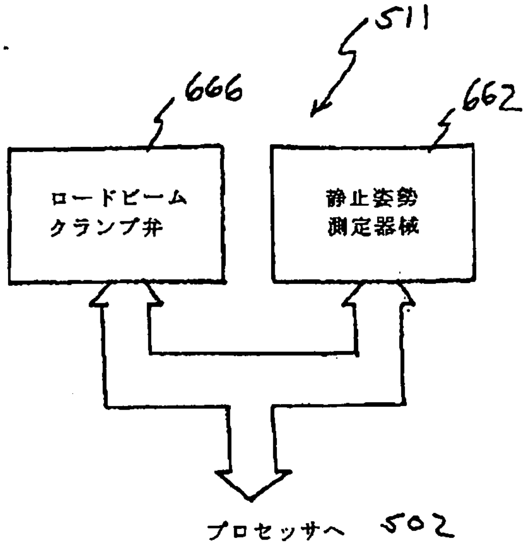
[Drawing 37]



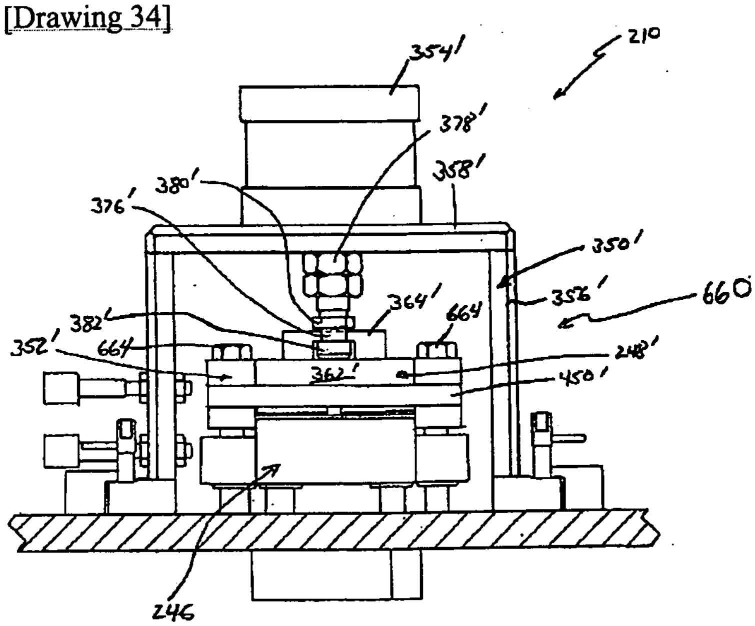
[Drawing 33]



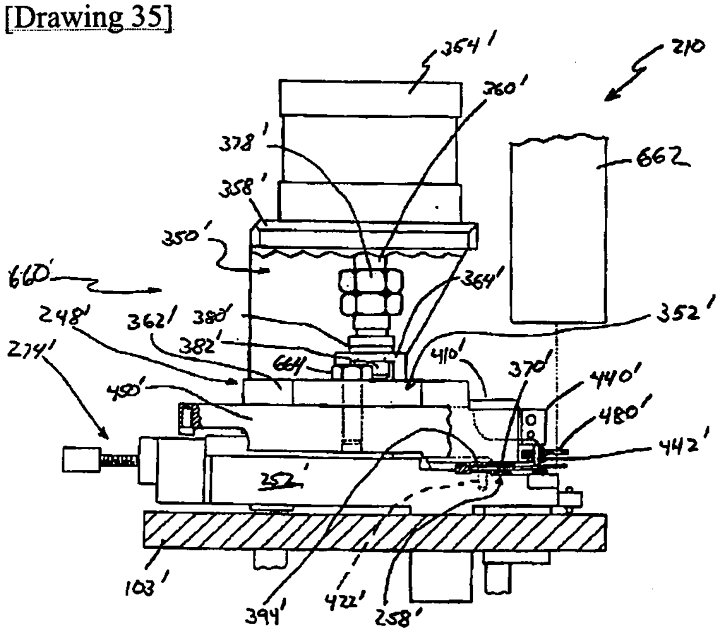
[Drawing 36]



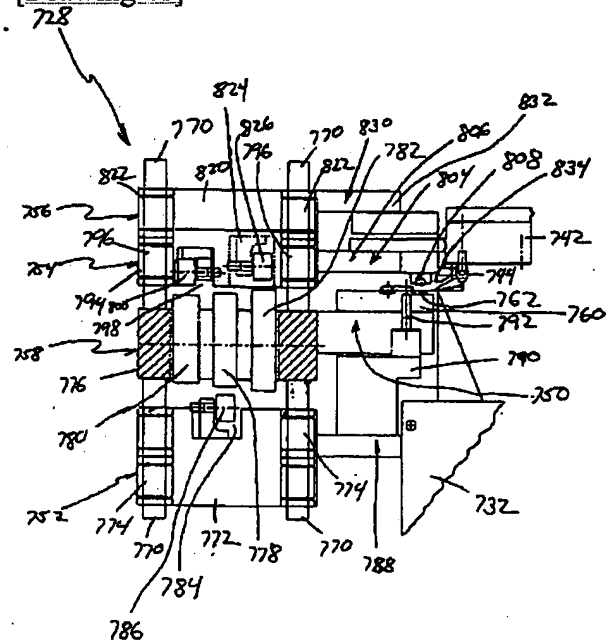
[Drawing 34]



[Drawing 35]



[Drawing 41]



[Drawing 38]

Dpitch = 所望のピッチ ー 測定した予備調整ピッチ 等式１
Dgram = 所望の荷重 ー 測定した予備調整荷重 等式２
Dheight = 所望の高さ ー 測定した予備調整高さ 等式３
Droll = 所望の巻き ー 測定した予備調整巻き 等式４
荷重 = ピン６１６Ａと６１６Ｂの平均位置 等式５
バイアス = ピン６１６Ａの位置 ー ピン６１６Ｂの位置 等式６
ピボット = ピン６１６Ｃの位置 等式７
バンプ = ピン４９６の位置 等式８

$$\text{ピボット} = u + v$$ 等式９

$$\text{バイアス} = \frac{Droll - M}{N}$$ 等式１０

$$\text{荷重} = \frac{Dheight - A - B \cdot Pivot^3 - D \cdot Bias}{C}$$ 等式１１

$$\text{バンプ} = -\left[\left(\frac{Dpitch - I - J \cdot Pivot^3 - L \cdot Load}{K}\right)^2\right]^{\left[\frac{1}{2 \cdot Power}\right]}$$ 等式１２

$$\text{定数} = E + F \cdot \left[\frac{Dheight - A - D \cdot \left(\frac{Droll - M}{N}\right)}{C}\right] + H \left[\frac{Dpitch - I - L \cdot \left(\frac{Dheight - A - D \cdot \left[\frac{Droll - M}{N}\right]}{C}\right)}{K}\right] - Dgram$$ 等式１３

$$\alpha = -\left[F \cdot \frac{B}{C} + H \cdot \frac{J}{K} - H \cdot L \cdot \frac{B}{C \cdot K}\right]$$ 等式１４

$$p = \frac{G}{\alpha}$$ 等式１５

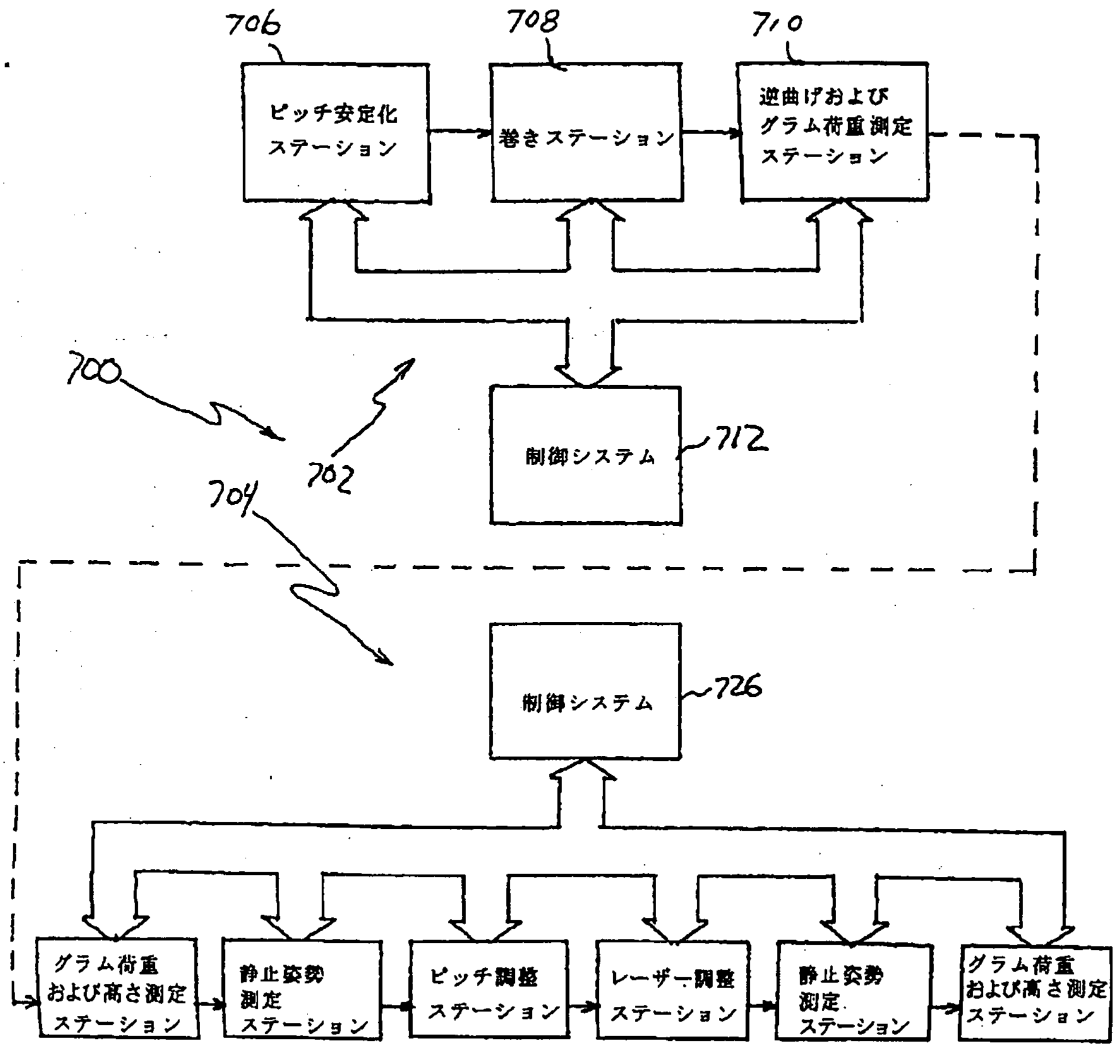
$$q = \frac{Constant}{\alpha}$$ 等式１６

$$Det = \left[\frac{p}{3}\right]^3 + \left[\frac{q}{2}\right]^2$$ 等式１７

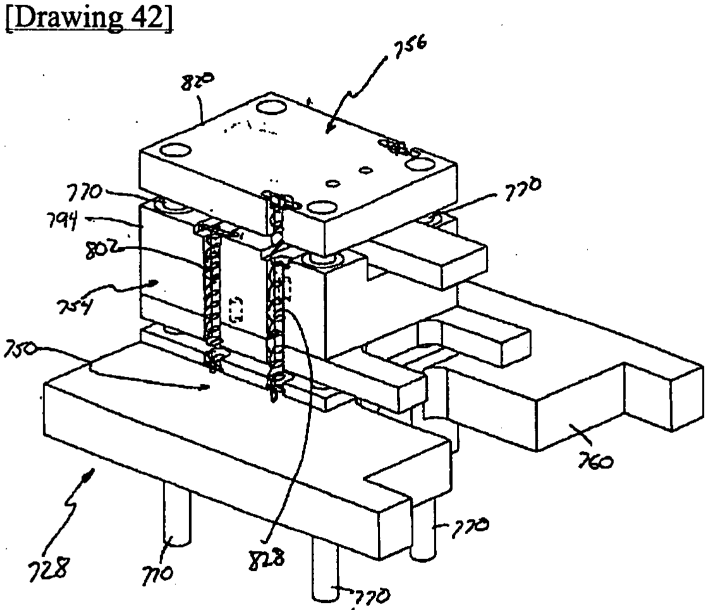
$$u = \left[\frac{-1}{2} \cdot q + Det^{(1/2)}\right]^{(1/3)}$$ 等式１８

$$v = -\left[\left(\frac{-1}{2} \cdot q - Det^{(1/2)}\right)^2\right]^{(1/6)}$$ 等式１９

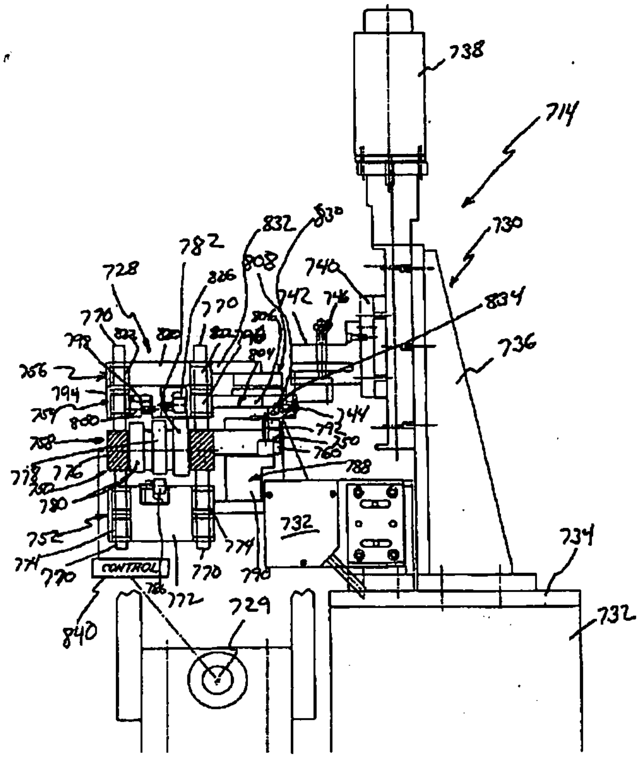
[Drawing 39]



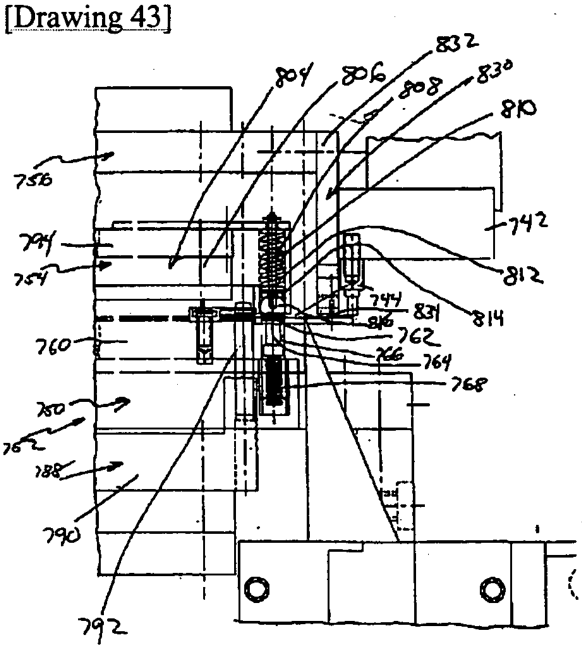
[Drawing 42]



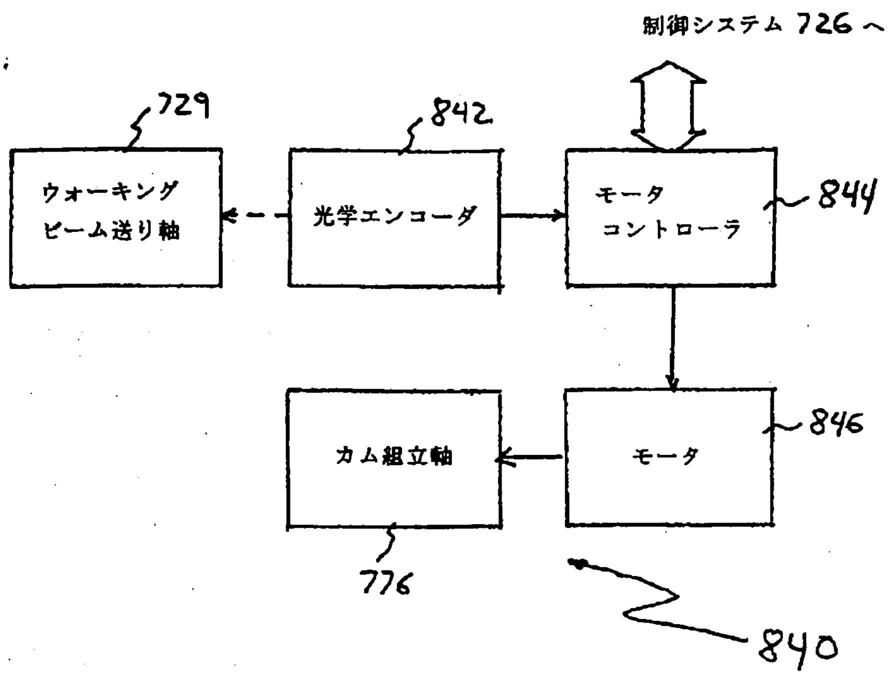
[Drawing 40]



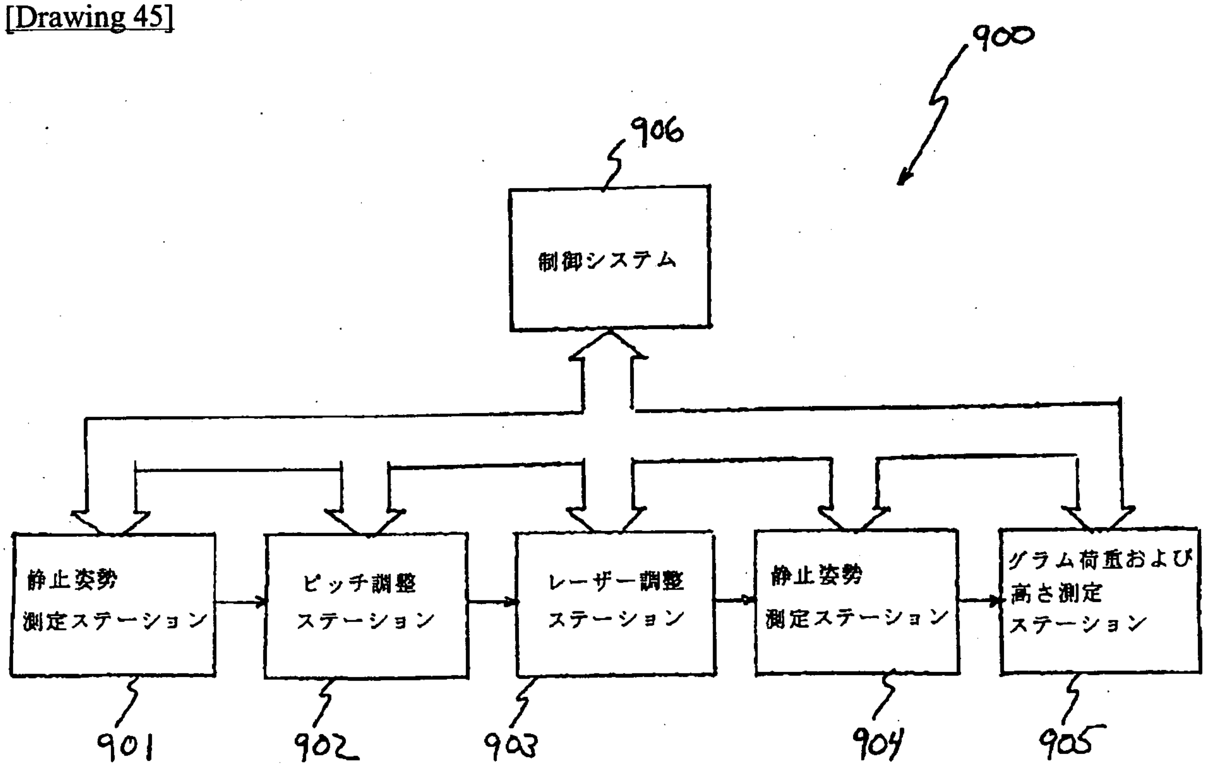
[Drawing 43]



[Drawing 44]



[Drawing 45]



[Translation done.]